Electrical World

The consolidation of ELECTRICAL WORLD and ENGINEER AND AMERICAN ELECTRICIAN.

VOL. 57. NEW YORK, THURSDAY, APRIL 27, 1911. No. 17.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

239 WEST THIRTY-NINTH STREET, NEW YORK.

JAMES H. McGRAW, President.
HUGH M. WILSON, 1st Vice-President. A. E. CLIFFORD, 2d Vice-President.
CURTIS E. WHITTLESEY, Secretary and Treasurer.
TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK

EDITOR.....W. D. WEAVER
A. S. M'ALLISTER.....Associate Editor
W. H. ONKEN, JR.....Associate Editor
W. E. KEILY.....Associate Editor
O. H. CALDWELL.....Assistant Editor
G. TISELL.....Assistant Editor
W. T. PEACOCK.....News Editor
S. S. BOIES.....News Editor
FREDERIC NICHOLAS.....Special Contributor
J. R. CRAVATH.....Special Contributor

CHICAGO OFFICE.....1570 Old Colony Building
CLEVELAND OFFICE.....1021 Schofield Building
PHILADELPHIA OFFICE.....Real Estate Trust Building
EUROPEAN OFFICE. ...Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico, $3.00 per year; Canada, $4.50 per year. All other countries, $6.00 per year. Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. Date on wrapper indicates the month at the end of which subscription expires.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday of the week of issue.

Copyright, 1911, by McGRAW PUBLISHING COMPANY.

Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World for 1910 *was* 974,750. *Of this issue* 17,250 *copies are printed.*

NEW YORK, THURSDAY, APRIL 27, 1911.

Editorial 1007
N. E. L. A. Membership 1010
Annual Report of General Electric Company 1010
Meeting of Philadelphia Electric Company Section of the N. E. L. A. 1010
Low Gas Rate for Chicago 1011
The California-Bound "Electric Special" 1011
Relation of Technical Men to City Planning 1011
Important Telephone Unification in Central States 1011
Atomic Theory of Electricity 1012
Meeting of New England Section, Electric Vehicle Association 1012
Discussion of the Electric Vehicle Situation at Boston 1013
Iowa Electrical Association Convention 1013
Electrical Manufacturing Plants in Europe. By Capt. Godfrey L. Carden, U. S. R. C. S. 1015
Excessive Rates Due to Holding Company 1017
New Rate Ordinance in St. Louis 1018
Public Utility Commission Law in Kansas 1018
Ohio Legislative News 1020
New Hampshire Public Service Commission 1020
Massachusetts Legislative News 1020
Wisconsin Commission News 1020
American Electrical Engineers. J. W. Fraser 1021
Current News and Notes 1022
Hydroelectric Development in Georgia 1025
Electric Welding and the Fusing of Metals. By A. S. Hatch 1028
Losses in Single-Phase Rotors.—II. By H. Weichsel 1030
Recent Progress in the Fixation of Atmospheric Nitrogen. By John B. C. Kershaw 1035
Municipal-Ownership Defeat at Lincoln, Ill. 1038
Continuously Connected Electrical Cook Stoves in Cleveland 1038
Showcase, Window, Outline and Sign Lighting 1039
Central Station Facts and Factors from Iowa 1039
Lighting and Electrical Equipment of a Central-Station Office Building. By Ross B. Mateer 1040
Ornamental Curb Lighting at Hamilton, Ontario 1042
School and Library Lighting 1043
Recent Telephone Patents 1045
LETTERS TO THE EDITOR:
Regenerative Control. By J. Gustaf V. Lang 1045
Rubber-Covered Wire Specifications. By W. Jones 1046
Digest of Current Electrical Literature 1046
Book Reviews 1050
New Apparatus and Appliances 1050
Industrial and Commercial News 1057
General News 1061
Weekly Record of Electrical Patents 1067

ELECTRIC ACTIVITY IN THE SOUTH.

The industrial development of the Southern States, which has proceeded with great rapidity in the last decade, is in nowise better exemplified than in the enterprise being shown in the construction of electrical transmission plants, especially for the distribution of energy to textile mills. An excellent example of this, described in the current issue, is the plant at Lloyds Shoals, near Jackson, Ga. This place is within easy reach electrically of a considerable group of enterprising and rapidly growing cities, so that the chance for a market is excellent. The plant is a good type of recent construction for the utilization of moderate heads, the fall in this case being 100 ft. The dam is of monolithic concrete about 1000 ft. long, and, owing to favorable topographical conditions, the station is placed at the dam, which forms part of the rear station wall. The river itself is the forebay of the plant, and the hydraulic design is therefore very simple, each wheel unit receiving water through a very short penstock and discharging it directly into the tail-race through short draft tubes. This hydraulic construction is singularly cheap and efficient and extremely favorable to the close regulation which is so important in hydroelectric plants. In this respect the Lloyd Shoals plant is one of the neatest which has yet been constructed.

The plant is not remarkable in rating or voltage, consisting merely of six 3000-kva, three-phase generators of ordinary design and construction. The transmission system is arranged for 66,000 volts, a value which must now be considered sufficiently conservative for long-distance plants. The electrical equipment is absolutely standard in its general character and while thoroughly worked out does not differ in any notable way from the ordinary constructions. It is simply a thoroughly workmanlike plant, containing the customary rather elaborate switching apparatus and safety appliances ordinarily recommended by the manufacturers. The transmission line is of the conventional steel-tower construction with large pin-type insulators, duplicate circuits being provided as usual in plants of this size. In the substations there are some features of interest. The most striking of these is the steel trussed framework provided entirely outside the substation for dead-ending the high-tension lines and supporting them entirely clear of the building and its connections. From this framework the high-tension lines pass to a steel tower on the roof of the station where the lightning arresters are installed, and thence the lines drop straight down through the roof to the high-tension oil switches. Although it looks intricate, this arrangement for supporting the lines on entering the station would appear to be very safe and substantial. The plant as a whole is an excellent example of the business-like, well-organized transmission station which has done so much toward the improvement of industrial conditions in the South. The hydraulic resources of the Appalachians, however, have as yet been drawn upon only in very moderate measure and much more of the same sort is available for the future.

GOING VALUE IN THE CHICAGO GAS CASE.

Some interesting conclusions in the matter of "going value" of a public utility are reached in a recent report made by Mr. W. J. Hagenah to the Chicago City Council in reference to the rates charged for gas by the company in Chicago. The general methods of analysis employed were similar to those used by the Wisconsin Railroad Commission, of which Mr. Hagenah is chief statistician. These were commented upon in our issue of April 6. The difference between the going value and the tangible physical-property value of a public-utility company is made up of the necessary expenses of getting the business started and the losses necessarily and justly incurred in putting the business on a successful and profitable basis. In going over the accounts of the gas company in Chicago, Mr. Hagenah makes a substantial addition to the physical value of the property in making up this total going value. However, he deducts from the going value the returns which have been made to the investors in the shape of profits, which are considered greater than those which may be assumed as fair. This is also in line with the decisions of the Wisconsin Railroad Commission. However, one of the most interesting points in the Chicago gas case is that Mr. Hagenah put in as going value money spent by the gas company in buying up competing companies and the losses connected with such competition. In his analysis he consistently follows out the theory that the granting of competing franchises of this kind is an economic mistake and that the public, through its officers, having granted such franchises, must allow the gas company to be reimbursed for the losses which the granting of such franchises has brought about. This is simply carrying to its logical conclusion the economic principle that competition in public utilities must necessarily in the end mean more expense to the user than regulated monopoly.

DETERMINING THE LOSSES IN ROTOR SECONDARY CIRCUITS.

An interesting analysis of the losses in the secondary circuits of single-phase induction motors is given in an article by Mr. H. Weichsel, the second and concluding part of which appears in this issue. The author's treatment is characterized by completeness in detail and hence should be of value not only to the designer of electrical machinery but to all those interested in investigating interrelated electromagnetic phenomena. In determining the losses in the secondary circuits of a coil-wound rotor it is desirable to analyze the emfs, mmfs and currents connected with the secondary coils, all of which are affected by the space-phase displacement of the coil sides—that is, by the coil-throw. By reason of the confinement of the secondary currents to definite paths the secondary mmf is not disturbed sinusoidally in space and its combination with the primary mmf produces a resultant mmf that is not sinusoidally disturbed, although it must have a time-phase value and space-phase position such as to produce a sinusoidal counter emf in the primary circuit when the impressed emf has a sine wave of time value.

The conditions are somewhat different in the case of a squirrel-cage rotor in which the secondary currents are relatively unconfined to definite paths, or rather are free to follow many different paths. In this case the combination of the primary and secondary mmfs is such as to produce a resultant flux which is distributed sinusoidally in both time and space. Superposed upon the load component of the secondary current is a current in space-quadrature therewith which serves to wipe out any irregularities in the resultant flux that would be produced by the direct combination of the primary current in its confined paths and the component of the secondary current which is opposed by the load component of the primary current. The space-quadrature secondary current has a value not departing widely from the "reduced" value of the primary exciting current when the secondary is open, and it produces a loss that is independent of the presence of the load component of the secondary current. When the space-quadrature secondary current is neglected it is safe to assume that the load component of the secondary current per rotor slot bears to the load component of the primary current per stator slot the inverse ratio of the slot numbers. When the load component of the primary current is known one can easily determine the load component of the secondary current by means of the slot ratio, and can then calculate the loss in the secondary conductor bars with the maximum of simplicity. To this loss must be added both the loss in the bars due to the space-quadrature secondary current and the loss in the end-rings in order to obtain the total secondary circuit losses. Since the currents over one half pole arc flow in a common direction through the end-rings at the point of maximum current, the determination of the end-ring loss is not difficult. It would seem, therefore, that the problem of calculating the losses in the secondary conductors of a squirrel-cage rotor is even simpler than determining the corresponding losses in a coil-wound rotor.

THE IOWA CONVENTION.

The two-day convention session of the Iowa Electrical Association at Davenport last week had crowded into it more useful information for the small central-station man than one often finds in a two-day state convention program. In fact, the first half-day session was enough to repay the average manager for attending. One of the notable features of this session was the presentation of the "facts and factors" committee report with some fundamental information from thirty-one stations operating in Iowa, ranging in size from those in towns of 700 population to that in the largest city in the State. From the good showing made on some of the items one must conclude either that Iowa central stations are more generally prosperous than some others or that those having the enterprise to report to the committee are naturally of the better managed and more prosperous class; we suspect the latter. One interesting fact noted in the report is an increase in the number of consumers per 100 population, which now averages in the neighborhood of ten. Taking the table as a whole, it indicates steadily bettering conditions in the shape of greater revenues for a given population; a natural result of increasing wealth in a very prosperous state. The increase in station equipment during the past two years has somewhat exceeded the increase in business. This, however, may be due to local conditions in some of the large centers where an increase of equipment has a considerable effect on the results.

The stations in communities of from 3000 to 10,000 population are, on the whole, making the best financial showing with the money invested. It is not safe to generalize from such limited information as this table contains, but the indication stated has been further verified by other observations in the central-station field. Stations operating in towns of from 3000 to 10,000 population frequently avoid some of the heavy investments connected with distributing systems in large cities and do not suffer so

much from the extreme smallness of the undertaking as those in towns under 3000 inhabitants. They are so large that they are out of the "one man" class, but nevertheless must operate with very simple plants and organizations. It is in stations of this size that combination with ice manufacturer, water supply and a limited amount of exhaust steam heating is most advantageous, and such combinations frequently are able to obtain a return on the investments which make the returns on some of the larger and supposedly more stable central-station investments look small. However, it is recognized that the smaller the company the greater the profits should be because of the risks in small companies.

The report of the committee which has been carrying on tests for two years on the resistance of different types of ground connections in Iowa soil reaches some very interesting and gratifying conclusions. Its tests showed that the most inexpensive types of connections are the best in the long run. Such luxuries as copper plates buried in coke or charcoal are inferior to plain iron surrounded with earth. This applies to Iowa black soil and moist clay, but might not be true under other conditions. The situation was well summed up by one member of the committee who pointed out that the resistance of a ground connection is dependent more on the conductivity of the moisture surrounding the plate than anything else. Finely divided earth retains more moisture near the ground plate than does coke or charcoal, hence the superiority of the earth.

RECENT PROGRESS IN THE FIXATION OF ATMOSPHERIC NITROGEN.

We live at the bottom of a nitrogen ocean, because the atmosphere consists essentially of nitrogen with adulterations, chief among which is, fortunately, oxygen. On every square meter of the earth's surface there rests a load of 8 tons of nitrogen. Notwithstanding this seeming superabundance of nitrogen there is some danger to the human race of a prospective nitrogen famine. The case somewhat resembles that of castaways on a raft adrift on the great ocean of sea water in danger of dying for lack of water in their tissues. A salient and remarkable property of gaseous nitrogen is its chemical aloofness, or disinclination to unite with other substances. Yet plants need nitrogen for their growth, and nitrogen enters into the composition of all living plants. No nitrogen no plant-growth seems to be an axiom of nature. It also appears that plants, although surrounded by gaseous nitrogen, are unable to help themselves to any nitrogen in this form. They require to take it in from the soil in the so-called *fixed* form—that is, in chemical combinations, principally nitrates. Animals also need nitrogen and fail to get it from the air. They derive all of their food ultimately from plants, and assimilate nitrogenous substances—proteids—which are necessary for the maintenance of animal life. In the processes of life these proteids are decomposed, and some of the decomposition products contain nitrogenous salts. Every crop of food-plants, such as wheat, gathered off the soil carries away a definite amount of nitrogen and impoverishes the soil to this extent. Manure containing animal excreta is capable of replenishing the nitrogen stock of the surface soil for the next crop. Unless, however, nitrogenous manure is fed to the soil it is only a question of time as to the exhaustion of the plant-supporting power of the soil under continual depletion by crops.

In the natural state—and without assistance from animals—there are two, and as yet only two, recognized means of restoring nitrogen to a soil that has given up its nitrogenous stock to marketed crops. One is by means of micro-organisms or microscopic plants in the soil. The other is by electric storms in the atmosphere. The nitrogen-producing bacteria, or microscopic plants, appear to have the power, denied to regular-sized plants, of absorbing nitrogen from the air and bringing it into combination with other substances—that is, of fixing nitrogen. These especially useful bacteria are fostered by the roots of certain plants; and the rotation of crops which was to some extent practised in ancient Egypt consists, when properly directed, not merely in giving intervals of rest to the nitrogen robbing of the soil by crops, but also in restoring the lost nitrogen by an intervening crop capable of fostering nitrogenous bacteria on its roots. The second natural restorative source of fixed nitrogen is the lightning flash. At the very high and momentarily applied temperature of the lightning discharge some nitrogen is forced into combination with the oxygen of the air. The amount of oxides of nitrogen formed in this way by a single flash can be only small, but the process is cumulative. The nitrogen fixed in this way sooner or later becomes absorbed by the soil and offered up to plants.

It may well be imagined that the natural rate of feeding nitrogen to the soil is slow, and that in the long run the crop production of the world's wheat tends to be limited by this slow rate of restoration. Artificial restoration by suitable nitrogenous plant food is, on the other hand, immediate; that is, it restores within the incubation period of a single crop. Moreover, 1 ton of a good artificial nitrogenous fertilizer, such as ammonium sulphate, applied to a proper surface area of soil is found to be as effective as 50 tons of farmyard manure. Hence the demand for cheap nitrogenous plant foods. Up to within the last few years the only commercial available sources of nitrogenous fertilizers have been the Chili saltpeter deposits, the island guano deposits, and the by-product of gas works. The first two supplies are necessarily limited in amount and are bound to become exhausted. The present yield of gas-works-fixed nitrogen is quite inadequate for the world's farms. In view of these facts some agricultural chemists have felt compelled to descend to pessimistic predictions of a future perpetual nitrogen famine and shrinkage of crops. But electrical engineering seems destined to dispel these fears for the present.

As Mr. John B. C. Kershaw describes in his interesting article in this issue, the electrical engineer is commencing to use a perpetual thunderstorm in an oven for the artificial production of fixed nitrogen, the natural rate of thunderstorm production being entirely too small for this purpose even in Colorado, where lightning plays in a clear sky. He shows that several plants are already at work in Norway, Austria and France taking hydroelectric energy in the mountains and producing flame arcs to which air is fed. The azoted air escaping from the flame is quickly chilled to prevent the dissociation of the nitric oxide formed and the nitric oxide is finally allowed to enter into the formation of nitric acid or some other nitrogenous compound. It is often feared that since water-powers are in the habit of presenting themselves in out-of-the-way parts of the world, remote from markets for energy, it may never pay to develop hydroelectric energy from the more remote falls. But if these recently introduced nitrogen-fixing factories develop to the point of producing fertilizer on a large scale it may be profitable to develop every large fall for fertilizer because there will always be air in abundance.

N. E. L. A. Membership.

On April 18 the total membership in the National Electric Light Association exceeded 7500. In July, 1909, the membership was 3135, and at the annual convention in St. Louis last May it was 5520. The increase thus far during the current association year has therefore been in excess of 2000, and the indications justify the belief that by the time of the annual convention next month even the very large growth of 1910 will have been exceeded and that a total of 8000 members will be reached. The growth is due to a variety of causes, and the new list given in the latest N. E. L. A. Bulletin not only includes several central-station companies but large lists from newer company sections, such as those in New York, Joplin, Mo., and Pittsburgh, Pa. At the present time company sections are being organized at Scranton, Pa., and Birmingham, Ala., and are expected to be in operation before the end of the month. It would appear that the association has now become the largest electrical society in the world. The officers expect confidently that in another year the membership will be at least 10,000.

Annual Report of General Electric Company.

According to the annual report of the General Electric Company the year 1910 was the most prosperous one in its existence, the total orders received aggregating $71,182,391, as against $60,483,659 in 1907, which was heretofore the banner year. The total number of orders and contracts received during the year was 338,272, exceeding all previous records. The sales department is careful to state that the increased business came largely from established customers in small contracts and current orders, rather than from new enterprises requiring large amounts of electrical apparatus. The high-voltage, direct-current railway system for interurban and steam railroad companies is increasing in popularity, much additional equipment having been ordered. Over 85,000 hp of 1200-volt direct-current motor equipments is now in service and on order.

During the past year the company's facilities for manufacturing Curtis steam turbines have been taxed to the maximum, and provision is being made for meeting the increasing demand. Curtis turbines having an aggregate rating in excess of 2,600,000 hp are now installed or on order. Several turbo-generators having a rating of 27,000 hp each are now in process of manufacture for the Commonwealth Edison Company and the New York Edison Company. The company has standardized a complete line of vertical and horizontal-shaft Curtis turbines for operation with high, mixed and low-pressure steam. The business of the foreign department was larger last year than in any previous year.

In his report to the president upon manufacturing and engineering, Mr. E. W. Rice, Jr., says that the expenditures for buildings and extensions and for additional equipment have amounted to $5,846,531.64 during the year, one-third of which has been applied to the enlargement of productive capacity. The total manufacturing area in square feet of floor space in 1910 was 8,530,000, the number of employees 32,000. Extensions were made to the Schenectady, Lynn and Pittsfield shops and to the lamp works at Harrison and Toledo. The total land area at all the works is about 608 acres. The policy of decentralization has been continued with most satisfactory results.

The company's engineers have confined their energies largely to the extension and improvement of existing lines of apparatus and supplies and to the design of special appliances to meet novel conditions. The size of the units employed in the generation and transmission of electricity has continued to increase, the company now manufacturing generators of 20,000-kw rating and transformers of 14,000-kw rating. Much attention has been given to the design of apparatus especially adapted to industrial works, such as paper mills, cement mills, cotton mills, steel mills and publishing houses. Advances have been made in devices for protection against lightning, and improvements have been made in steam turbine generators. Substantial progress is reported in the development and improvement of wiring devices, rheostats, circuit-breakers, switches, instruments, meters and arc lamps. A most noteworthy advance has been made in the metallic-filament incandescent lamp by the use of a new filament of drawn wire, developed by the engineers in the company's research laboratory.

The company expended $564,097.38 during the past year in acquiring sundry patents, for the cost of applications and licenses under patents and in patent litigation and miscellaneous expenses. The book value of the stocks and bonds of affiliated manufacturing and selling companies owned by the General Electric Company is given as $8,225,879.05. In addition, the book value of the stocks of the security-holding companies, consisting of the United Electric Securities Company of Boston, the Electrical Securities Corporation and the Electric Bond & Share Company of New York, is $6,262,397.67. The value of stocks and bonds of local lighting and railway companies in its possession is placed at $8,322,206.01. The book value of the factory plants is given as follows: Schenectady works, $8,567,953; Lynn works, $3,896,858.27; Pittsfield works, $1,898,831.53; lamp works, $1,152,671.67. The company has invested in copper mines $1,129,961.63, represented by capital stock, and $1,675,115.22, represented by advances. This investment includes the Bully Hill Copper Mine, Winthrop, Cal., a railway company and other equipment, and the properties of the Hermosa Copper Company, in Grand County, New Mexico. The total value of the outstanding debenture bonds on Dec. 31, 1910, was $14,962,000. The total capital stock of the company authorized Dec. 31, 1910, was $80,000,000, of which $65,179,600 has been issued, the balance, with the exception of $1,912,066.67, which has not been issued, being reserved against debentures. The profit for the year ended Dec. 31, 1910, was $10,855,692.13, and the surplus carried forward to the next year $23,022,705.82.

Meeting of Philadelphia Electric Company Section of the N. E. L. A.

The regular monthly meeting of the Philadelphia Electric Company Section of the National Electric Light Association was held on April 17. Three papers were presented. The first, by Mr. George F. Peifer, was entitled "A Historical Sketch of the Philadelphia Brush Station," which was the first electric light station operated in Philadelphia and with which Mr. Peifer has been connected as chief engineer for the past thirty years. Much of the apparatus installed thirty years ago was in active use, or capable of being used, until six months ago, when the station was reconstructed and changed to a motor-generator station.

The second paper was on "The Phenomena of Cyclones, Tornadoes, Etc.," by Mr. George S. Bliss, section director of the United States Weather Bureau. The talk was a popular one, and as a section of Philadelphia had been recently visited by a tornado the remarks on this variety of wind disturbance were particularly interesting. Mr. C. J. Russell, of the Philadelphia Electric Company, described the course of the recent tornado in the vicinity of Tacony. All the trees, telegraph and electric light poles and buildings in its path were seriously damaged. The storm destroyed all the electric wires radiating from generating station "J" of the Philadelphia Electric Company, so that the station was completely shut down. A remarkable piece of aerial line construction was accomplished within the next six days, as some seventy 65-ft. poles were erected and 60 miles of wire strung, a large portion of which was No. 0 in size. Service was reintroduced to the principal consumers within twenty-four hours by the installation of about 1 mile of three-conductor cable buried about 15 in. below the surface of the ground. The entire service was restored within five days and within six days the station was operating normally. The work was accomplished under most trying conditions, the weather being particularly cold and high winds prevailing.

The membership committee announced a total membership of 449, and the prize award committee announced the award of

a first prize to Mr. J. W. Sylvester, who suggested the placing of ducts in the foundation walls of building operations for underground service instead of waiting for service orders, which usually arrive so late that the duct has to be introduced at considerable damage to the property, and the award of a second prize to Mr. Frank T. Adams, who suggested a change in the numbering of the working order system. There were in attendance 300 members and guests.

Low Gas Rate for Chicago.

A report presented to the City Council of Chicago on April 17 by its committee on gas, oil and electric light contains an exhaustive report on the subject of gas rates from Mr. W. J. Hagenah, the expert retained by the committee. As a result of his investigation Mr. Hagenah asserts that the People's Gas Light & Coke Company could sell its product at 77 cents per 1000 cu. ft. instead of 85 cents, the present price, and still pay 7 per cent interest to its stockholders, with an annual surplus of at least $141,753. The total value of the company's investment is fixed at $61,849,879 in 1910. The value of the physical property is placed at $49,023,947, the office building owned by the company being excluded. There is an elaborate discussion in the report on the subject of intangible values. No value is given to the franchise, but a large allowance is made for "going value," due to the losses which the company has sustained in the development of its business. Much of the difference between value of total investment and of physical property is made up of "going value." No action was taken on the report. It is reported that the officers of the gas company will appeal to the courts to prevent the establishment of a 77-cent rate. On the other hand, there are many who demand that the rate be made as low as 70 cents, the new Mayor, Mr. Harrison, being elected largely on the 70-cent gas issue.

The California-Bound "Electric Special."

A jolly party of ladies and gentlemen, with a sprinkling of youngsters, numbering 159 persons in all, left the Dearborn station in Chicago at 8:20 p. m. on April 18 bound on a leisurely trip to California. The travelers consisted of members of the Electrical Supply Jobbers' Association and their friends and guests, who were for the most part on their way to the convention of the association to be held in Del Monte, Cal., on April 25 to 27. Most of the members of the party are taking advantage of the occasion to enjoy a vacation, and many of them will remain away from their Eastern homes for a month or more.

The train, which left over the Santa Fé Railroad, consisted of twelve cars, including nine Pullman sleepers, two dining cars and one club car. For sight-seeing purposes it was scheduled to stop at Laguna Pueblo, in New Mexico, and the Grand Canyon of the Colorado. At Upland, Cal., automobiles were provided, and the last 40 miles of the journey to Los Angeles was taken by this means through the orange country of southern California. At Los Angeles the party was taken in hand by the Pacific Coast jobbers, although the train was chartered to go through solid to Del Monte, arriving there on the evening of April 24.

The arrangements for the special train were in charge of Mr. F. Overbagh, general secretary of the association, and various forms of amusement were provided to while away the long trip, including various musical and vaudeville "stunts," as well as the publication of a daily paper. A large number of Chicago electrical men assembled at the railroad station to see their friends depart, and when the train pulled out a burst of cheers followed it.

Many well-known electrical men are in the party. A hasty look around on the eve of departure revealed among them the following: Messrs. F. N. Boyer, John F. Gilchrist, T. G. Grier, N. G. Harvey, W. W. Low, W. W. Merrill, F. Overbagh, E. K. Patton, Louis Schwab, T. C. Ringgold, E. O. Sessions, Chicago; H. W. Bliven, B. M. Downs, P. M. Fletcher, C. I. Hills, George L. Patterson, E. W. Rockafellow, New York; J. Robert Crouse, H. H. Cudmore, F. S. Terry, Cleveland; John McNaughton, W. H. Seldon, Jr., Detroit; John W. Brooks, Solvay, N. Y.; Daniel Hemingray, Covington, Ky.; A. P. Munning, Milwaukee.

Relation of Technical Men to City Planning.

Mr. William B. Jackson, consulting engineer, was the principal speaker at the luncheon of the Electric Club of Chicago on April 12. His subject was "The Relation of Technical Men to City Planning." Mr. Jackson referred to the work of the Chicago Plan Commission, indorsed by the Chicago Association of Commerce, and said that technical men should take a broad view of the subject. Methods of transportation, water supply, sewerage, gas supply, electric service and telephone distribution are involved. Then there are the various aspects of sanitation, the provision of playgrounds and the important consideration that the city as a whole should be made attractive or even beautiful for the purpose of making its inhabitants better satisfied with their surroundings.

The great value of suitable workrooms is recognized. Working places should be made attractive as well as provided with utilitarian accessories in doing work. The same is true of electric power houses, for instance, and the returns on the extra investment to secure attractiveness may be considered to be ample in the greater satisfaction and loyalty of employees. As power plants are planned for future extensions, so should cities be built to some rational, comprehensive plan. Plenty of light, power, air and attractiveness should be provided for all the people and the whole city, and not alone in work places and during working periods. The great work is to make more efficient men and women. The speaker concluded by asking for the hearty support of electrical men in furthering the work of the Chicago Plan Commission.

Mr. Albert Scheible spoke of the progress in Europe in city planning. It is unfortunate, he thinks, that the existing Chicago Plan was prepared largely by architects and artists, without the advice of technical men.

Mr. Frederic P. Vose said the problem consisted in reforming the people themselves. Mr. H. E. Niesz spoke of the work of the Board of Health of Chicago in improving the cleanliness and sanitation of school children and their homes in the poorer districts. Mr. Frank L. Perry referred to the "human engineering" of the National Electric Lamp Association as a significant tendency in the right direction, Mr. James H. Delany added a few words, and Mr. George P. Player, of Oklahoma City, also spoke briefly. A vote of thanks was extended to Mr. Jackson.

Important Telephone Unification in Central States.

Arrangements have been perfected by which the management of five large Bell telephone companies in the Central States will be centralized in Chicago. At the annual election of the Central Union Telephone Company, held in Chicago on April 19, these officers were elected: President, Mr. B. E. Sunny; vice-president and treasurer, Mr. Alonzo Burt; vice-president in charge of commercial department, Mr. B. W. Trafford; general manager, Mr. H. F. Hill; secretary Mr. Charles E. Mosley; general counsel, Mr. L. G. Richardson; auditor, Mr. Benjamin S. Garvey; chief engineer, Mr. J. G. Wray. These are substantially the same officers that were elected at the meeting of the directors of the Michigan State Telephone Company in Detroit, on April 11 They will also be elected substantially by the directors of the Wisconsin Telephone Company at Milwaukee, and later by the Cleveland Telephone Company at Cleveland.

The fifth company is the Chicago Telephone Company, and the executive headquarters of the five affiliated companies will be in Chicago. Mr. Sunny, who is president of the Chicago

Telephone Company and a vice-president of the American Telephone & Telegraph Company, will be at the head of the new affiliation. Mr. Mosley is the secretary of the Chicago company, Mr. Garvey is auditor and Mr. Wray is chief engineer.

The five companies in the present unification have been working along smoothly with their diverse organizations, but it has been felt that by making a larger operating unit and by the centralization of management increased efficiency can be secured.

The companies of which Mr. Sunny will be the head will serve a combined territory having an area of 247,450 sq. miles and a population of 18,250,621, or about 20 per cent of the population of the United States. The total number of Bell telephones in use in this area is 1,491,577; the number of employees of the five companies is 23,141, and the value of the plants is $110,000,000.

The Wisconsin Telephone Company has for its territory all of that State. The Chicago Telephone Company covers the northeastern portion of the State of Illinois. The Central Union Telephone Company has the remainder of Illinois, all of Indiana and all of Ohio except Cleveland and Cincinnati. The Michigan State Telephone Company has all of that State, while the Cleveland Telephone Company covers the city of Cleveland, Ohio.

The policy of grouping Bell operating companies into much larger operating units is in execution of a definite plan adopted by the American Telephone & Telegraph Company, which is the parent organization. There are now twenty-six licensee companies in the United States, and it is proposed to combine the operation of these into seven or eight larger groups. This operating system has already been put into effect in New York State and New Jersey, and is now being carried out in the Central West, as indicated above.

Atomic Theory of Electricity.

In former numbers of the *Electrical World* (most recently in the issue of Dec. 1, 1910, page 1276) have appeared several references to the important and interesting work carried on at the Ryerson Physical Laboratory, University of Chicago, by Dr. R. A. Millikan, professor of physics in the university, with the assistance of Mr. Fletcher. These experiments relate to the isolation of atmospheric ions on minute droplets of oil floating in the air. It has been shown that all electrical charges are built up of elementary atoms of electricity, and the value of this ultimate electrical atom has been accurately determined. Readers of this journal will be interested in the following account of the extensions of the investigation now under way as reprinted from *The Daily Maroon* of April 13:

"(1) The act of ionization itself is now being studied, each of the two electrical fragments into which a neutral molecule breaks up being caught upon oil drops at the instant of formation. This study has shown that the act of ionization of a neutral air molecule always consists in the detachment from it of one single elementary charge rather than of two or three such charges. In other words, the phenomenon of valency does not exist in gaseous ionization.

"(2) by suspending these minute oil drops in rarefied gases instead of in air at atmospheric pressure the experimenters have been able to make these oil drops partake of the motions of agitation of the molecules to such an extent that they can be seen by any observer to dance violently under the bombardment which they receive from the flying air molecules. By measuring accurately the amount of the motion of agitation of the oil drops and comparing it with the motions which they assume under the influence of an electrical field because of the charge which they carry, the investigators have been able to make an exact and certain identification, with the aid of computations made by Mr. Fletcher, of the electrical charge carried by an atmospheric ion (and measured in their preceding work) with the electrical charge carried by univalent ions in solution.

"This work not only furnishes complete proof of the correctness of the atomic theory of electricity, but gives a much more satisfactory demonstration than had before been found of the perpetual dance of the molecules of matter."

A number of noted physicists have viewed these interesting experiments. A recent visitor was Professor Pflueger, of the University of Bonn, Germany.

Meeting of New England Section, Electric Vehicle Association.

A New England Section of the Electric Vehicle Association of America was organized at the Edison Building, Boston, at a meeting on April 17. The meeting was called to order by Mr. Day Baker, New England manager of the General Vehicle Company, who stated that the results of the work of the Electric Vehicle and Central Station Association had borne fruit in the organization of the present national association, and that it was desirable to carry forward the New England development in co-operation with the more inclusive body. Mr. E. S. Mansfield, of the Boston Edison company, moved that a New England Section be organized, and upon the unanimously favorable vote resulting, the following officers were elected: President, Mr. E. S. Mansfield, Boston Edison company; treasurer, Mr. John A. White, National Battery Company; secretary, Mr. W. F. Kimball, of Charles H. Tenney & Company; executive committee, Messrs N. T. Wilcox, of Stone & Webster; O. F. Brastow, General Electric Company; H. L. Converse, Studebaker Brothers Company; A. F. Neale, Baker Motor Vehicle Company; E. C. Baugher, Westinghouse Electric & Manufacturing Company; C. A. White, Boston Edison company; Frank J. Stone, Electric Storage Battery Company; Day Baker, General Vehicle Company, and P. E. Whiting, S. R. Bailey & Company.

At the conclusion of the business meeting Prof. Dugald C. Jackson, of the Massachusetts Institute of Technology and president of the American Institute of Electrical Engineers, outlined the plans of the Massachusetts Institute of Technology for electric-vehicle research work at Boston. Professor Jackson said that as a result of an appropriation by the Edison Electric Illuminating Company of Boston through the initiative of President C. L. Edgar a fund is available for a year's research into the higher economics of the electric vehicle. The authorities of the institute and the Edison company as well feel that the assembly of data, the discussion of tests, preparation of cost figures and general conduct of research with full publicity by an absolutely impartial organization will be of immense value in molding public opinion and in disclosing any sources of weakness in design or operation, pointing the way toward improvements in practice and showing in a genuinely scientific manner exactly what can be expected of the electric commercial and pleasure vehicle in service of a specific character.

Among the points which will be investigated are the cost of operation and maintenance under enlightened treatment, reliability of service, comparative cost of horse, gasoline and electric-vehicle operation, merits of tires and roadways, results of the operation of the public garage of the Boston Edison company under the auspices of the Electric Vehicle Association of America; types of daily logs which may be desirable; reports of owners and drivers as to service performance; economics of routes in delivery and other service, and the assembly of information now possessed by different manufacturers into a comprehensive grouping. Professor Jackson said that the institute would probably send a representative to various cities where the electric vehicle has attained a high stage of commercial utilization for the purpose of securing data, with further visits to vehicle factories. It is hoped that many suggestions of general interest to the industry may thus be advanced. Regarding the fear that the interests of different manufacturers might be injured by the pursuance of such an open policy, Professor

Jackson said that in any new and growing industry publicity is a supremely powerful factor for progress, and he emphasized the point that the enormous progress of electricity within the past generation is very largely due to the willingness of workers in every field to share the benefits of their discoveries and experience.

Various representatives of manufacturing houses present indicated their willingness to co-operate in the work. Mr. Day Baker said that desultory research work has already been carried on for some time by some makers of vehicles, and he cited several users of commercial vehicles in New York that have established record systems of high value, notably the Motor Vehicle Delivery Company, which handles the mails north of Forty-second Street. Mr. Frank J. Stone emphasized the fact that the electric vehicle has already attained a very large and successful development. Mr. N. T. Wilcox said that the Lowell Electric Light Corporation has decided to discard all its horse-drawn service and that it has confidence in the business capabilities of the electric vehicle. Two other Stone & Webster companies are likely to follow the example of Lowell in the near future. Mr. Baker said that he is frequently asked to lecture on electric-vehicle development, and he has strongly advised every vehicle manufacturer to have lantern slides made of his most representative equipment, so that the full range of development and the possibilities of the work can more effectively be brought home to the audiences. Special efforts are made to give non-partisan lectures, and the educational work is bound to result in good to all concerned in the progress of electric-vehicle service.

Discussion of the Electric-Vehicle Situation at Boston.

The first of a series of luncheons to be given to facilitate the exploitation of the electric vehicle in New England was given by the Edison Electric Illuminating Company of Boston on April 20. About twenty representatives of electric-vehicle manufacturing companies, members of the Boston Edison staff and guests convened at the office of General Superintendent W. H. Atkins at noon, and after an informal interchange of greetings and experiences were escorted into the company's conference room, where a dainty buffet luncheon of electrically prepared edibles was served. At the conclusion of the luncheon Mr. Atkins called the meeting to order and a committee was appointed later to nominate officers for an organization of electric-vehicle dealers at Boston, the meeting having previously voted to form an association to further the progress of the work.

A letter was then read from the Anderson Electric Carriage Company, offering to sell 100 Detroit electric runabouts to central stations in the New England field at the manufacturing cost, in order to enable the electric companies to encourage the development of this service throughout their territory. The letter pointed out that in the city of Detroit alone the sale of energy for vehicle charging amounts to over $7,500 per month, and 90 per cent of this service comes off the peak. The manufacturers are convinced that there is an equal opportunity for development in New England if the companies will only take the initial steps. A copy of the letter has been sent to every central station in New England.

Mr. Atkins announced that the Boston Edison company is ready to install large and striking electric signs advertising pleasure and commercial electric vehicles at strategic points in the territory, notably near the L Street generating station in South Boston, where the advantages of electric automobiles and trucks will be set forth for the benefit of the great excursion traffic which passes up and down Boston Harbor, and at conspicuous points in Boston proper, the outer Back Bay and Somerville. Five large signs are to be erected at first, and these will be supplied with energy by the company without charge. Mr. Atkins also offered to send out in the name of the Edison company a letter to selected customers calling attention to the advantages of electric vehicles, the mailing list to be prepared in line with suggestions of the representatives of the vehicle dealers having offices in the Boston district. Mr. L. D. Gibbs, superintendent of advertising of the Edison company, stated that plans are afoot to assemble the various automobile editors and advertising men connected with the Boston press at a dinner to be given by the company for the purpose of bringing out more clearly the growth and possibilities thus far attained and indicated in the electric-vehicle field. Mr. Day Baker, of the General Vehicle Company, reviewed recent progress in the field, including the following impressive comparison between the efficacies of the commercial gasoline and electric machines. In a large commercial garage containing both gasoline and electric trucks the electric machines are in service 98 per cent of the time during the working hours of the day, compared with a maximum of 79.5 per cent for the gasoline outfits, and this in spite of the fact that the gasoline cars have the advantage of having been more recently purchased by the business house in question.

Iowa Electrical Association Convention.

The Iowa Electrical Association held its eleventh annual convention at the Coliseum, Davenport, Ia., April 19 and 20, 1911. The first session was called to order on Wednesday morning, when President Thomas Crawford, of Clinton, introduced Mayor Alfred Mueller, of Davenport, who welcomed the convention. He complimented the association on its selection of Davenport for its meeting place and on the fine collection of exhibits on display. He said further that the convention city was well chosen because of the cordial relations existing between the public and city officers and the public-service corporation. He complimented the local central-station and railway interests on their service and fair dealing. He did not believe in the Des Moines plan (Des Moines is one of the cities having the commission form of government). He said that in a hearing as to a certain bill before the Legislature a Des Moines official had boasted that since the commission form of government went into effect in Des Moines all of the public-service corporations had been brought into court. Davenport's boast is that it has never had to bring its public-service company into court.

Mr. L. D. Mathes, of Dubuque, responded to the address of welcome on behalf of the association. Commenting on the electric service in Davenport, he said that the service and rates are fair—in fact, neighbor companies sometimes think almost too fair—to the public. The low rates made in Davenport because of the water-power and large quantities generated are not always possible in other communities and other companies are sometimes embarrassed in explaining the difference. He complimented Davenport on its progressiveness, as shown by the special curb illumination on its down-town streets. This plan has also been adopted at St. Paul, Minneapolis, Des Moines, Kansas City, Duluth and many smaller towns.

President Crawford then gave his address, calling attention briefly to notable points in the industry during the past year. He said that most of the Iowa central stations operated under certain disadvantages, among which he named the high price of coal, the small size of the communities and the long distances from electrical manufacturing centers. He said that during the past year there had been notable advances in lamp manufacture and in meters. There had also been a reduction of price in both lamps and meters. Certain electrical conveniences have now practically become necessities in well-regulated homes. Among these necessities are the electric iron and vacuum cleaner. There has been much increase in the amount of ornamental curb lighting. A number of bills for the regulation of public utilities have been introduced in the Legislature and the work of some members in Des Moines appearing at the various hearings on these bills was commended. He urged members to take more interest in proposed legislation. In general, he thought there is more cordial feeling between the public and public-service companies throughout the State than formerly.

Mr. Austin Burt, of Waterloo, who is the "facts and factors" committee of the association, presented a very complete report on Iowa central stations. He tabulated the results from thirty-one stations, giving various facts, including the items used by the *Electrical World* in similar tables it has presented from time to time, and also several additional items. This table appears elsewhere in this issue. The results as compared to similar results obtained by Mr. Burt two years ago show an increase in business which indicates that the tungsten lamp has not had the effect of reducing the demand. This report was discussed by Prof. A. H. Ford, of Iowa City; Messrs. A. J. Young, of Cedar Rapids; H. G. Glass, of Pittsburgh; J. R. Cravath, of Chicago, and others. In executive session at the close of the convention this committee was continued.

The committee on "grounding of secondaries," which has been a standing committee of the association for several years, presented a report giving results of tests on different forms of ground connections, part of which were installed at Iowa State College, at Ames, and others at Iowa State University, at Iowa City. Some of these grounds have now been in service for two years. Prof. A. Shane, of Ames, presented the results obtained and the comments of the committee, which were further commented on by Prof. A. H. Ford, of Iowa City. The tests in general showed conclusively that plates buried in coke and charcoal are less reliable as grounds than plates in plain Iowa soil. They also indicated that plain iron is better than copper. On the whole, the results showed that some of the elaborate and expensive methods of grounding commonly recommended in the past are not as good as some of the cheaper methods using plain iron pipes or plates. The failure of coke and charcoal is presumed to be due to the fact that it is not as finely pulverized as earth and, therefore, does not hold the moisture so well.

Professor Shane also called attention to the existence of an appropriation for carrying on the State Engineering Experiment Station and said that it is the desire of those responsible for this station to get in closer touch with the electrical industries of the State, and that the station is prepared to perform any experiments within reason which would be of general benefit if the association would indicate what experiments are considered desirable.

Mr. A. L. Dodd, of Charles City, reporting on behalf of the membership committee, presented applications for membership from central stations at Jewell, Maquoketa and Fairfield.

A nominating committee was elected consisting of Messrs. A. L. Dodd, of Charles City; L. D. Mathes, of Dubuque; Austin Burt, of Waterloo; F. J. Hanlon, of Mason City, and George S. Carson, of Iowa City.

The Wednesday afternoon session was opened with a paper on "Transmission and Distribution System Record," by Mr. Ira L. Craig, of Waterloo. He described the system followed at Waterloo for keeping track of the company's distributing lines and the connected transformer load. This was followed by a discussion which was mainly on the sizes of wires used for the smallest feeders and services. The practices in Waterloo, Charles City and Chicago, Ill., were discussed.

"Refrigerating Advantages and Disadvantages" was the subject of a paper by Mr. G. W. Dumont, of Omaha. He took up first the operation of ice plants in connection with central stations and, second, the supply of electric energy for driving refrigerating machines on consumers' premises. He gave some figures on the power necessary for motor-driven ice machines. He criticised the inability of some central-station companies to quote rates promptly on motor-driven refrigeration plants, and said that the companies should get their rates into shape so that prices could be quoted without delay when the ice-machine salesman is about to close a contract with a prospective buyer. He thought 48 kw-hours ample energy per ton of ice. He thought any rate not exceeding 4 cents per kw-hour would be satisfactory for motor-driven refrigerating plants. This paper drew considerable discussion. Mr. Mathes, of Dubuque, especially urged co-operation of the central-station man with the ice-machine salesman. Mr. Rufus E. Lee, of Clarinda, spoke unfavorably of electric-motor drive for a combination light and electric plant.

Mr. H. B. Gear, of Chicago, read a paper on "Underground Distribution in Medium Cities," which gave valuable information on costs and methods to be pursued in underground work and in combination of underground and overhead lines. He also gave pointers on making overhead lines as inoffensive as possible. Unit costs were given for various underground work. One point brought out in the discussion was the extensive use of steel-armored cable buried directly in the ground for cheap underground work in parkways, lawns, etc.

Prof. A. H. Ford read a paper on "Flat Rates for Small-Demand Consumers," which analyzed the question which has recently been brought up so prominently of supplying certain small consumers at a flat rate with some flicker device to limit the maximum demand. His analysis was favorable to such business. The discussion following showed considerable difference of opinion as to the merits of the scheme. Mr. Young, of Cedar Rapids, reported having tried it at that place, and Mr. J. R. Cravath reported a limited experience with the plan at Harrisburg, Ill. The general sentiment of others, including Messrs. A. W. Zahn, of Mason City; Austin Burt, of Waterloo, and Gear, of Chicago, was adverse to the plan.

On Wednesday evening the supply men gave a complimentary smoker to the central-station men at the Hotel Davenport.

On Thursday morning the convention listened to a brief paper by Mr. F. H. Golding, general manager of the Rockford (Ill.) Electric Company, on the "Electric Automobile," telling of the remarkable development of the electric-vehicle business in Rockford, where 165 electric vehicles are in use. This paper included figures on the cost of maintenance of electric vehicles and the revenue which they brought to the company. President Crawford pointed out how remarkably far behind Rockford most other cities are in electric-automobile development. A number of questions were asked Mr. Golding, and the discussion finally drifted into the introduction of the electric truck. Some figures were given on the performance of these, although there appears to have been but little progress made with their introduction.

"Ornamental Curb Illumination" was taken up in a paper by Mr. R. M. Parker, of Ft. Dodge. He outlined different methods of getting this kind of lighting introduced in cities. He thought the cost should be paid for out of the city treasury after installation by the property owners. He advocated posts with five lamps for large cities and with three lamps for small. This paper was discussed by Messrs. A. L. Dodd, Prof. A. H. Ford and others.

Mr. Harry G. Glass, of Pittsburgh, presented a set of lantern slides intended to arouse the enthusiasm of the central-station man as to the possibilities of the general introduction of electric-motor service for all purposes in a community. He also proposed a rate system which was criticised in the discussion as being adverse to certain rulings already made by the Wisconsin commission and therefore unlikely to be held equitable in the future.

On Thursday afternoon Mr. J. D. A. Cross in a paper on "Industrial Heating Loads" told briefly of the numerous possible applications of electricity to industrial heating processes and gave some figures on cost of operation in specific cases. This paper led to a discussion of electric-heating appliances in general.

"Public Policy" was the subject of a brief address by Mr. George S. Carson, of Iowa City. He said that companies are realizing the importance of this subject more every day. Good service is of first importance in a wise public policy. The rates must not discriminate unjustly between consumers, and concessions must not be secretly made to certain consumers which are not made to others of a similar class. The voluntary lowering of rates as rapidly as can be done under existing operating conditions is good policy. A liberal use of newspaper advertising enables the company to tell its side of the case or to advertise its service as necessity may require. Another important matter is prompt attention to complaints. Every

employee of the company is looked upon as a representative of the company, therefore every employee should be cautious and courteous in his statements. For example, the tact of an employee has much to do with the ease of procuring the permission to trim trees. The company should aid in all public improvements and help them along in a public-spirited way.

In the discussion Mr. A. L. Dodd said that he liked to contribute to public affairs and did not mind being considered an easy mark. But even supposing he did not enjoy it he thought it would be good policy to make such contributions. Mr. R. M. Parker, of Ft. Dodge, read an advertisement appearing over the name of a central-station company doing a wiring business which called attention to the danger of fire with improper wiring and the number of fires caused by the wiring of one of its competitors in the wiring business. This was read as a good example of what not to do in the way of advertising. Mr. I. L. Craig, of Waterloo, told of a fire in the new First Methodist Church of that city just as it was completed. This was charged to electric wires, but the city electrician responsible for the inspection promptly took up the matter and had the electricity turned on the building circuits in the presence of several witnesses after the fire without touching the wiring to repair it. The wiring was thus shown to be intact. Mr. A. D. Ayres, of Keokuk, said that his company used to do wiring, but had turned the work over to good contractors, who built up a good business. Later when irresponsible boys had undertaken contracting his company had found it necessary to refuse to connect to wiring not thoroughly and properly done. Mr. P. B. Sawyer, of Des Moines, pointed out that not only is good electric service necessary, but good office service likewise. That is, customers must be treated courteously and have complaints attended to promptly at the office if the public is to be satisfied. Mr. Carson said that companies should be ready to test meters carefully whenever consumers make complaint, even though there may appear to be little probability that the complaint is just. President Crawford said that his company now installs nothing but glass-case meters so as to overcome any suspicion by the customer that the meter is running with no load. He also tried to teach consumers to test their own meters and so dispel some of the mystery. He thought it a good thing to make public the earnings of the company just as the local company in Davenport had done the day before. Even though the earnings were high, the comments of the local press had been favorable. The problem of tree trimming is largely a question of tact. He had once accomplished with the owner's consent the trimming of an exceedingly troublesome tree by offering to do other trimming of nearby trees for the owner at the same time.

In settling complaints Mr. H. G. Blackwell, of Davenport, advocated employment of a recording instrument to show when and how much energy was used. A record on paper makes the consumer much more contented. He described one case of a gas consumer who could not understand large bills in a certain month when the consumption was theoretically very low. The use of the recording instrument indicated considerable gas consumption at hours when all gas was supposed to be turned off. Investigation revealed a number of gas jets in out-of-the-way places where they would often be used unnoticed. The same principle applies to electric consumers.

At the executive session at the close of the Thursday afternoon session the following officers were elected: President, Mr. H. C. Blackwell, of Davenport; vice-president, Mr. P. B. Sawyer, of Des Moines; secretary, Mr. A. W. Zahm, of Macon City; treasurer, Mr. W. A. Mall, of Belle Prairie; executive committee, Messrs. L. D. Mathes, of Dubuque; A. L. Dodd, of Charles City, and J. P. Jones, of Cedar Falls. Des Moines was selected as the place for the 1912 convention.

The president-elect is general superintendent of the People's Light Company, of Davenport, which carries on the gas and electric business of that city, and the Davenport Gas & Electric Company, which carries on the exhaust-steam heating business. Mr. Blackwell is thirty-three years of age. He was born in Montreal, Canada. His early education was received in the public schools and in the Cincinnati Technical School. He graduated from the Purdue University, engineering course, in 1902. Upon graduation he went with William B. Scaife & Company and was engaged in the design and erection of water-purification plants. In 1905 he entered the employ of J. G. White & Company, and was assistant superintendent during the construction of the interurban lines from Alton to Granite City, Ill. In 1906 he left Alton to go to Davenport, where he was first engaged in engineering and construction work. For the past three years he has been general superintendent. Important improvements have been going on under his supervision, and his company is just completing the placing underground of all wires in the fire-limit district of Davenport. The Davenport company is under the control of the firm of J. G. White & Company.

President-Elect H. C. Blackwell.

Electrical Manufacturing Plants in Europe.

By Capt. Godfrey L. Carden, U.S.R.C.S.

The Charleroi electrical works are one of the important electrical manufacturing plants of Belgium. The shops are located at Charleroi on the line of railway between Paris and Liège. This firm has shown net earnings of $193,000 in a single year on a total capitalization of $965,000. The machine-tool installation comprises 510 machines, representing an outlay of $386,000.

The outputs of the Charleroi works include electrical equipment of great variety. This firm is exporting to all parts of Europe, and in particular to Russia, Spain, Italy, Turkey, Egypt and South America. The rates of pay of various operators are, in United States money: Lathe men, 7.7 cents to 12.5 cents per hour; milling-machine men, 7.7 cents to 11.6 cents; planer hands, 7.7 cents to 9.6 cents; stamp-press men, 5.8 cents to 8.7 cents; radial-drill operators, 6.7 cents to 8.7 cents, and foremen, 15.2 cents to 19.3 cents.

A large proportion of the machine tools in service at Charleroi are of American origin, and the equipment from the United States is in high favor. The engineer-in-chief of the shops declares that, after a careful calculation based on the prices asked for American boring mills and for foreign tools of the same sizes, having regard to the weights involved in both machines, the prices charged per kilogram of weight he found were practically the same. On the face of it, he remarked, the American machines would appear to be more expensive, but the difference in price was made up by the greater weight in the American tools.

The Ganz works of Hungary have long been regarded as one of the first electrical manufacturing plants of the world. The shops are located on the outskirts of Budapest and employ about 1200 people. At present the main outputs are in connection with power plants and electric traction work.

A noteworthy Ganz installation is the 30,000-volt Manojlovoc power station, located in Dalmatia, containing four 30,000-volt, 42-cycle, three-phase, 4500-kw generators driven by Francis turbines. The line potential, 30,000 volts, generated directly by the machines without step-up transformers, is transmitted a distance of twenty miles and then transformed down to 50 volts at one step, so that the 1500-kva transformers have a ratio of transformation of 600 to 1. No trouble has been experienced, it is reported, at the Manojlovoc station in more than two years of service.

The name of Ganz is identified with much of the best in electric locomotive work abroad. Electric locomotives built by this company have a total rated output of 2000 to 2800 effective horse-power, yielding a maximum bar pull of 42 tons. This rating is regarded as theoretical only, since no real drawbar, it is pointed out, could stand the strain, and the adhesive weight at 42 tons is not sufficient for executing more than from 9 to 10 tons under favorable conditions. Ganz first introduced the three-phase system in connection with railway-traction work on the Valtellina line in Italy. Three of the Valtellina locomotives were loaned at the outset for use on the Simplon tunnel route.

The visitor to the Ganz shops is impressed with the fact that the establishment is more than a mere manufacturing one; in other words, Ganz stands for the origination of some of the best laboratory ideas in Europe. The names of such men as Blathy, Dery and Zipernowsky are associated with many of the distinguishing features bearing the Ganz name. It was Ganz who first brought out transformers with closed magnetic circuits, and also first connected these in parallel. Ganz also claims to have been the first to do away with belt and chain drives, coupling directly between generators and steam engines. It is asserted that this was done as early as 1889. Among other claims by the Ganz works is the distinction of first bringing out the wattmeter for accurately measuring alternating-current power. This was in 1885. They also designed alternating-current watt-hour meters based on the induction principle. Important equipment produced at the Ganz shops comprises large transformers, turbo-dynamos, electric traction outfits, controlling apparatus and arc lamps. No attempt is made to manufacture telephone and telegraph material.

The Ganz shops contain many fine examples of American machine tools. Some of the very latest designed tools from the United States are in evidence, and the Ganz firm is in the market at all times to secure new and meritorious machines. A day's work comprises ten hours. The better grade of workmen receive about 1 crown (20.3 cents) per hour. Apprentices receive 50 hellers (10.2 cents) per day. These apprentices serve three years, putting four to five hours each working day at night school.

In Hungary many of the power-station engines in service are the make of Messrs. Lang, of Budapest. The Lang engines are well constructed and invariably well finished. At the Budapest central station there are three of these Lang engines of the vertical triple-expansion type, direct-connected to generators, the high, intermediate and low-pressure cylinders measuring 60 cm, 82.5 cm and 140 cm, respectively, by 80 cm stroke. These engines run at 112 r.p.m.

Alongside the Lang engines are Zoelly turbines, also the make of Lang. It is the practice now to build Zoelly turbines complete in one casing. The exciters for each of these machines are mounted on the same shaft with the motor. The effectiveness of the Lang shops may be gathered from the fact that their per-man capacity, figured on a year's basis, is 5,468 crowns ($1,110). The average rate of wages paid good machinists is 62 hellers (12.6 cents) per hour. Foremen receive 1 crown (20.3 cents) per hour. Apprentices receive 12 hellers (2.4 cents) per hour.

In the big steel works of Austria-Hungary gas engines are much used for driving generators. The writer has no hesitancy in saying that the best gas-engine work coming under his notice was at the Witkowitz steel works of Moravia. These Witkowitz works employ approximately 28,000 people. This is one of the great iron and steel plants of Europe. Witkowitz is to Austria what Krupp is to Germany. Both the Witkowitz and Krupp plants are privately owned works. The blast-furnace works at Witkowitz are divided into two groups, that at Witkowitz proper and a second group at Sofienhutte. In the Sofienhutte group there are three blast furnaces with outputs, respectively, of 260 tons, 200 tons and 120 tons, or a total of 580 tons per day. The gas derived from these furnaces is used for fuel in a central station near by. In the central station there are two steam engines of 1400 hp and 800 hp respectively, and two of 4600 hp.

The writer has observed many gas engines in service in Europe, but nowhere, except possibly at the Resicza works in southeastern Hungary, did he witness such fine showings as at Witkowitz. The gas engines at Sofienhutte and at Witkowitz proper ran with all the smoothness and quietude of a beautifully adjusted steam engine—no shock and no jar. One 1200-kw gas engine seen at work made no more noise than a turbine which it paralleled. This gas engine was a double-acting tandem unit. All Witkowitz gas engines are of the Otto type, built under Witkowitz modifications. As an illustration of the effectiveness of the Witkowitz gas engines the statement was made that they are in use 99 per cent of the working time, running almost continuously night and day. Such slowing down as is required by the gas engines does not exceed 1 per cent of the entire period.

Witkowitz builds gas engines only for its own use, and its gas engines are to-day being run by men familiar with every element in their construction. This must necessarily have much to do with the success of operation. In answer to the question why Witkowitz does not build gas engines for others, the reply was made that Witkowitz had no time at present for outside gas-engine orders.

There are four blast furnaces at Witkowitz proper, that is to say, other than at Sofienhutte, comprising two of a rating of 250 tons each and two which range from 150 tons to 200 tons each.

At the Sofienhutte station the power derived from the combined steam-engine and gas-engine installation is utilized for operating blowing engines at this point. At Sofienhutte the gas for the blast furnace is passed into a washer of Witkowitz design, containing fans, where it is first roughly cleaned. The gas next passes into a second washer, also of the same Witkowitz design, where it is further washed, and thence through a large system of fans. These fans are all of Witkowitz type. The gas is then dried in two driers, from which it passes directly to the engine. When too much gas is available the surplus gas goes into the air.

The Resicza works in Hungary, another great iron and steel plant, is working 6000 people, but the total force employed in all the shops and works of the company in the Hungarian territory alone is 18,000.

Resicza has been utilizing blast-furnace gas for the past thirty-five years, and to-day a large proportion of the power produced comes from the gas engines. Both blast-furnace and producer gas are used. The gas-producer system employed is of the Kerpely design. In the steel-making department there are fourteen gas producers in series. In one central station there are four gas engines, each of 1650 nominal horse-power, running at 97 r.p.m. The engines were built by Lang, of Budapest, after the Eberhardt system. The 1100-kw generators came from the Allgemeine Elektricitäts Gesellschaft, Vienna, and produce 5500-volt, 208-cycle, three-phase alternating current. All four engines run in parallel with a second hydro-electric central station of 6000 kva rating. Resicza employs a gas washer, the design of General Director Veitte, supplemented by an additional washer built on the Theisen system. From the Theisen washer the gas goes direct to the gas engine, without recourse to any gas reservoirs. Arrangements exist whereby producer gas can be used at any time in the event of blast-furnace gas giving out.

Excessive Rates Due to Holding Company.

The Massachusetts Gas and Electric Light Commission has issued an order reducing the prices of gas and electricity as charged by the North Adams Gas Light Company, upon complaint of over twenty customers, as required by Sec. 34, Chap. 121 of the Revised Laws. The decision includes an extremely important discussion by the board of the holding-company principle, and in general the commission finds that the exercise of control in this case through the holding device tended to maintain too high prices for the company's products. The board also orders a restriction of the minimum-charge feature of the company's rates. The decision is one of the most significant that have been issued by the board in recent years.

The North Adams company has been supplying both gas and electricity since 1890. Its products are distributed in North Adams, Adams and Williamstown, and it supplies electricity alone to a local company in Stamford, Vt. About 70 per cent of the gas output is sold in North Adams and 89 per cent of the electrical income is derived from that source. In North Adams the maximum net price of gas is $1.05 per 1000 cu. ft. with special discounts to certain large consumers. The maximum net price for electricity for lighting is 13½ cents per kw-hour, with lower rates to customers using more than 15 kw-hours a month. The maximum net price for motor service is 4 cents per kw-hour, with a minimum charge of $1 per month for each horse-power of motors installed. These prices were made on Jan. 1, 1910, and represent reductions from previous maximum net prices of 30 cents per 1000 cu. ft. for gas and 1 cent per kw-hour for motor service. When these reductions were made a minimum charge of 50 cents a month was imposed for gas customers whose net bills average less than that during the year and of $1 a month for electric light customers whose net bills average less than that amount. Particular complaint was made at the hearing against these minimum charges, none of which had been previously included in the company's tariff.

The board's investigation of the company's operations for the fiscal year 1910 showed that, although the dividends for the year were somewhat increased, even with no allowance for depreciation, the gross profits were not sufficient to pay the interest and dividend charges, these being paid in part from the surplus previously earned. The operating costs for the gas and electric departments amounted respectively to 85 per cent and 88 per cent of the income. Considering that these figures indicated that either the selling prices are already too low or the operating costs too high, the board made a careful examination of the company's accounts, its business methods, and many of its contracts, invoices and vouchers, which were all found to be kept with care and precision. During the year 1909 practically all the capital stock was acquired by the Massachusetts Lighting Companies, an unincorporated voluntary association, which controls sixteen other gas and electric companies in the State, and the Light, Heat & Power Corporation, chartered under the laws of West Virginia. The last-named company is organized for the purpose of manufacturing, selling and purchasing machinery and appliances, building, equipping, leasing and selling water, light, power and heat plants and pipe lines, and furnishing machinery and appliances to be used in such connection, and in maintaining and operating such plants. The responsible officers are identical with those of the North Adams Gas Light Company. Nearly all the latter's operations, and especially its plant construction and purchase of supplies, are virtually carried on by the Light, Heat & Power Corporation. This relation is not evidenced by a written contract, but is secured through the identity of their ownership and of their principal executive officers. The board examined the books of the Light, Heat & Power Corporation and found that there existed a substantial profit to the latter upon nearly all the supplies purchased from it by the North Adams company. These commissions amounted to about $27,000 in 1910, with the addition of sums paid for engineering services. The board points out that the accounts of the North Adams company show under the present management a very large increase in that part of the operating cost represented by the salaries of the executive officers, who occupy similar positions in the Light, Heat & Power Corporation and receive from it compensation for their services to that concern. The board says: "To determine definitely the reasonable compensation of the incumbents of these respective positions is a matter of great difficulty, but, in view of the peculiar relations of the Light, Heat & Power Corporation to the others, it may be safely assumed that the salaries actually realized by the executive officers of the Light, Heat & Power Corporation as such ought to be, and are in fact, quite the full compensation of these officers for their entire services in behalf of the allied corporations; that the combined salaries apparently paid to these officers by the several companies are larger than the volume of the business or its character would justify or the interests of the owners, the Massachusetts Lighting Companies, would permit. * * *

"The method of carrying on the business thus described has not only contributed to advance the operating costs to the high percentage named, but the rendering of monthly bills by the Light, Heat & Power Corporation for its numerous claims against the company has kept the North Adams company almost constantly in debt to it, making necessary the immediate transfer of most of its income directly to that corporation, and has enabled the Light, Heat & Power Corporation to add to its other profits interest upon the average balance of the debt thus created. All the facts combined lead to the conviction that the method of carrying on the business has substantially increased the current charges of the company beyond what they might be were the business conducted in the manner usual with an independent company. The whole arrangement tends to mislead the public as to the actual reasonable cost of carrying on the North Adams company, and so is directly contrary to the spirit and purpose of the law providing for the regulation and supervision of such concerns. The company ought not to pay twice for carrying on its affairs. * * * It is the duty of this board in fixing a price to determine whether the operating costs are reasonable and fair. * * * The public is concerned with the character of the management and the reasonableness of its cost. The company is entitled to a reasonable profit above only reasonable costs. Reasonable profits presuppose or are based only on reasonable costs.

"In justification of the course of dealing between the two companies it may be urged that because of the large purchases of supplies by the Light, Heat & Power Corporation for the several companies to which it is related it can supply them at a profit to itself for less than the individual concerns cay buy in the open market. To some extent this claim may be successfully made, but, in the opinion of the board, the actual charges for this service to the North Adams company are too great to be justified under that proposition. In so far as a unified management of a group of companies actually promotes economy in operation and increases the ability to serve the public it is entitled to commendation and a liberal reward, but even under these conditions it is neither necessary nor wise that the entire profit from that endeavor should be taken from the owners. It is not a question whether any additional profit is to be accorded to superior management, but rather how much is reasonable and fair. The outstanding capitalization of the association controlling these companies, which amounts to more than $3,500,000 and is greatly in excess of the capital stock and bonds which its subsidiary lighting companies might under the most liberal administration of the law be authorized to issue, and the peculiar relation assumed by the Light, Heat & Power Corporation create a situation whose necessities invite the taking of a heavy toll from the public. In view of these facts and principles the board is of the opinion that a further reduction in the maximum price for both gas and electricity may reasonably be required of the company, and that the prices hereinafter named are sufficient to cover reasonable operating expenses, including a proper allowance for depreciation and a fair return upon the value of the property which the company is reasonably and actively employing for the public convenience.

"With respect to the minimum monthly charges for gas and

electric lighting the money value of these charges is not important to the company. No such charge had been made by the former management. The company had been and would probably continue to be prosperous without it. It is supported by the claim that the readiness of the company to supply is a convenience to the customer and a service which has value even though he may not actually use the light, and that such service is of some cost to the company, which ought not to be required to render any service at a loss. The statutes appear indirectly to recognize the legality and justice of some charge in the case of the gas supply, but make no attempt to determine its fair and reasonable amount. It is under any conditions extremely difficult to determine the cost of such service. * * * If any such charge is to be made, its amount must, therefore, be determined somewhat arbitrarily with reference to other considerations rather than its cost. While it is doubtless true that any public-service company may sometimes be legally and reasonably required to render certain services without a demonstrable profit or even at less than the apparent cost, to require a company to give any service continuously or repeatedly at an obvious loss would be manifestly unjust and inexpedient. When any amount of gas or electricity is used for which the customer pays the company receives some return, and while it may be impossible to show that such return is an adequate one, it may be equally difficult to prove that it has been rendered at a perceptible loss."

The board, therefore, recommends that from May 1, 1911, the net price of gas shall not exceed $1 per 1000 cu. ft.; that the net price for electricity for any use shall not be over 12½ cents per kw-hour; that no minimum charge for gas shall be made against any customer for any month unless in that month the customer uses less than 100 cu. ft. of gas, nor during a portion of twelve consecutive months if during such time the customer uses gas to the value of $7, and that if the minimum charge be made it shall not exceed 50 cents for any one month, and that no minimum charge for electricity for lighting shall be made by the North Adams Gas Light Company for any month unless in that month the customer uses less than 1 kw-hour, nor during any portion of twelve consecutive months if during that time the customer uses electricity for lighting to the value of $12, and that if any minimum charge be made it shall not exceed $1 for any one month.

New Rate Ordinance in St. Louis.

The new ordinance regulating electric rates in St. Louis, mention of which was made in last week's issue, is to go into effect six months from April 12, the date of its approval by Mayor Kreismann. The ordinance fixes a maximum rate of 9.5 cents per kw-hour and a minimum service charge of 50 cents per month. Printed schedules of rates are to be filed in the office of the Public Service Commission of St. Louis within six months after the approval of the ordinance, and thereafter schedules are to be filed whenever changes are made in rates. The rates indicated on the schedules shall not be effective until thirty days after they have been filed, unless in the opinion of the commission, declared in writing, an emergency exists, in which event a schedule may become effective immediately.

A charge for the installation of meters of not to exceed $2 may be made, and meters shall be furnished for the use of consumers free of cost. In all cases where the maximum rate is paid no charge shall be made for renewals of 8-cp, 16-cp, 24-cp or 32-cp carbon-filament lamps of the regular clear-glass type upon the return of burned-out lamps with glass unbroken. No person desiring to obtain energy shall be required to contract not to use other means than electricity for light or motor service. No person who desires electricity at the maximum rate shall be required to contract for a longer period than one month. No rentals shall be exacted for service connection or meters. No customer who pays the maximum rate shall be required to guarantee the use of any fixed amount of energy or the payment of any fixed sum except the service rate of 50 cents per month. In all cases where the company contracts to furnish energy at a rate lower than the maximum it may require a guarantee of not more than the equivalent of the maximum rate of 9.5 cents per kw-hour for the energy actually furnished. No customers' deposits in excess of two average months' bills shall be required, and upon these deposits interest shall be allowed at the rate of 5 per cent per annum.

Where a special investment in addition to the ordinary cost is required to provide a service connection from mains adjacent to the customer's premises the company may require a reasonable guarantee sufficient to cover the cost of such special investment. Overhead service connections in the overhead district and underground service connections in the underground district shall be furnished free of charge, provided that the connection from the street-service lines adjacent to the premises to the inside walls of the customer's premises shall not be longer than 100 ft. If the connection exceeds that length the customer may be required to pay a reasonable cost for the excess.

No meter shall be used which has an error of registration in excess of 3 per cent on light load or full load. Each service meter shall be tested and adjusted for accuracy at the time of installation, and shall be tested thereafter at least once a year by comparison with suitable standards of light-load, half-load and full-load rate of operation. A complete record of all meter tests shall be kept by the company. Upon the request of a consumer a company shall test a meter, provided the request is not made more frequently than once in six months. A report thereof shall be made to the consumer. If the test shows an inaccuracy beyond 3 per cent, the amount of the bill last rendered shall be adjusted in accordance with the inaccuracy and settlement made. Upon written application of a consumer to the supervisor of city lighting a test of the meter shall be made by the supervisor, who shall charge a fee of $1, to be paid by the consumer if the meter is found to be slow or accurate within the allowable limit and by the company if it is found to be fast beyond the allowable limit. In the latter case the fee shall be returned to the consumer. If the meter is found to be inaccurate beyond the allowable limit, the amount of the bill last rendered shall be adjusted and settlement made between the consumer and the company.

The ordinance applies to every corporation, association, copartnership or person engaged in furnishing or selling electrical energy in the city under any permit, privilege or franchise granted by the city or the State. Violations shall constitute a misdemeanor, punishable upon conviction by a fine of not less than $50 and not more than $500 for each offense. Every case of violation shall constitute a separate offense. The city reserves the right to alter, amend or repeal the ordinance at any time.

Public-Utility Commission Law in Kansas.

The new public-utility commission law in Kansas, which has been signed by the Governor, makes the Board of Railroad Commissioners a public-utility commission with greatly enlarged powers. The law applies to telephone, telegraph, dining-car, heat, light, water and transmission companies, as well as common carriers, although mutual telephone companies are excluded. Public utilities owned and operated by municipalities are excepted from the provisions of the act.

The present members of the Railroad Commission retain their offices for the terms for which they were elected, but thereafter the commissioners shall be appointed by the Governor, one to be a practical, experienced business man, and another experienced in the management or operation of a common carrier or public utility. Of the three persons to be appointed, one is to serve for one year, one for two years and one for three years, and upon the expiration of these terms commissioners are to be appointed for three years. The salary of each commissioner is to be $4,000 per year, and not more than two members of the commission are to be of the same political party. No person

owning securities in any common carrier or public utility, or in any way pecuniarily interested in any company subject to the law, shall be eligible unless he divests himself of such interest or employment to the office of commissioner, attorney or secretary of the commission. Neither commissioner, attorney nor secretary shall hold any office of profit or any position under any committee of any political party, or hold any position of honor, profit or trust by virtue of the laws of the United States or of the State of Kansas.

Every company shall be required to furnish reasonably efficient and sufficient service, joint service and facilities, and to establish just and reasonable rates and rules. Every company shall publish and file with the commission copies of all schedules of rates. The commission shall have power to prescribe reasonable rules regarding the filing of schedules of rates. No company shall knowingly or wilfully charge a greater or less compensation for the same class of service than is specified in the printed schedules, or receive any rate not specified, except that different rates may be charged by agreement with the customer in cases of charity, emergency, festivities or public entertainment, and officers, employees and agents of the utilities companies may have free or reduced rates.

It shall be the duty of the commission, either upon complaint or upon its own initiative, to investigate all rates, and if the commission, after full hearing and investigation, shall find that such rates are unjustly discriminatory it shall have power to fix just and reasonable rates. If the regulations are unreasonable and inefficient the commission shall have power to substitute other practices and to make such order respecting changes as shall be just and reasonable. Upon complaint regarding rates or practices by any organization or society, or by any taxpayer, firm or corporation the commissioners shall proceed, with or without notice, to make such investigation as they may deem necessary. No order affecting rates or practices against which such complaint is made shall be entered by the commission, however, without a formal public hearing. The commission shall have power to require such improvements as may be required by law.

Whenever any company desires to make changes in rates and practices it shall file a schedule with the commission indicating the changes, which shall not be put into effect without the consent of the commission. Any company or other party in interest who is dissatisfied with any order of the commission may commence an action within thirty days in a court of competent jurisdiction to vacate such order on the ground that its provisions are unlawful or unreasonable. All actions brought under this section shall have precedence in any court. Appeal from the decision of the District Court may be taken to the Supreme Court of the State, but during the pendency of any action all orders of the commission shall remain in force until final judgment is rendered.

The commission may prescribe for each kind of public utility suitable and convenient standard commercial units of products and service. It shall provide reasonable regulations for examinations of such service and the measurement thereof. It shall establish reasonable rules and standards to secure the accuracy of the meters.

Each public utility shall furnish, in such form and at such times as the commission shall require, accounts showing unit figures for depreciation, the various classes of expenses and revenues, dividends and interest, etc. Each company shall transmit to the commission on or before Sept. 15, 1912, and on or before the same date each year thereafter a full statement for the period ended on the June 30 preceding. Failure to make such reports within the time specified causes forfeiture to the State of $100 for each day of default.

It is stated that the power to create liens on corporate property in Kansas by common carriers and public utilities is a special privilege, the right of the supervision of which shall be vested in the State. A company may issue securities payable at periods of more than twelve months after the date thereof when necessary for the acquisition of property, carrying out corporate powers, construction, completion, extension of improvement of facilities, or for the improvement or maintenance of service, or the discharge or lawful refunding of obligations, or such other purposes as may be authorized by law, provided that there shall have been secured from the commission a certificate stating the amount, character, purposes and terms of issue, and that the statements in the application have been ascertained to be true.

Any company, or any agent, director or officer thereof who shall issue or cause to be issued any securities contrary to the provisions of the act or who shall apply the proceeds from the sale thereof to any purpose other than that specified in the certificate shall be guilty of a misdemeanor and upon conviction shall be subject to a fine of not less than $500 and not more than $5,000, or by imprisonment in the county jail for not more than one year, or by both fine and imprisonment. No company after the passage of the act shall acquire or hold any part of the securities of any competing company unless authorized by the commission.

The commission shall have the power, and it shall be its duty, to ascertain the reasonable value of all property of any company whenever it deems the ascertainment of such value necessary in order to enable it to fix fair and reasonable rates. Authority is given to the commission to examine all accounts.

Unless otherwise ordered by the commission it shall be unlawful for any company to receive a greater compensation for any service than the charge fixed on the lowest schedule of rates for the same service on Jan. 1, 1911. Accidents involving loss of life or serious personal injury are to be reported immediately by telegraph to the commission, which may investigate such accidents.

Every municipal council or commission shall have power to contract with any company as to quality of service and maximum rates, conditions and maintenance and penalties. Complaint regarding such ordinance may be made to the commission by the company affected or by ten or more taxpayers, and a date shall be set for a hearing. If the commission shall find that any provision of such ordinance is unreasonable, or against the public welfare or interest, or if it has reason to believe that the ordinance may be contrary to law, it shall recommend such changes as may be necessary. If the municipal council or commission shall not amend the ordinance to conform to the recommendations of the Public Utilities Commission the latter may commence proceedings in any court of competent jurisdiction to set aside any ordinance because of its unreasonableness or illegality, or because the measure is not for the promotion of the welfare of the municipality.

No company shall issue any securities, either directly or indirectly, or receive any money, property or service in payment thereof until there shall have been recorded upon the books of the corporation the certificate of the commission relating to the issue of securities. No company governed by the act shall declare any stock, bond or scrip dividend or divide the proceeds thereof among its stockholders unless authorized by the commission. No franchises shall be assigned, transferred or leased, nor shall any contract or agreement with reference to such franchises or rights be valid unless approved by the commission. Any person who shall wilfully make any false entry in the accounts of a company subject to the act, wilfully destroy any accounts, wilfully neglect to make full and correct entries in such accounts, or falsely make any statement required of him to the commission, shall be guilty of a felony, and upon conviction shall be punishable by a fine of not less than $1,000 or more than $5,000, or by imprisonment of not less than one year or more than three years, or by both fine and imprisonment.

The commission may at its discretion issue orders specifying records which may be destroyed after a reasonable time. If any company governed by the act shall violate any of the provisions thereof, or shall fail to obey any requirement made by the commission, or any final judgment of court upon appeal, it shall forfeit for every offense not less than $100 and not more than $1,000. Any act of any officer, agent or other person acting for the company within the scope of his employment shall be in every such case the act of the company, and every day during which there shall be such violation shall constitute a separate offense.

Ohio Legislative News.

The sub-committee of the committee on railroads and telegraphs of the Ohio Senate is hard at work revamping the Winters public utilities bill to accord with ideas the members may have received during the numerous hearings that took place last week. If the bill is made up to suit some of the telephone interests represented at these hearings it will be minus almost everything but a provision allowing the consolidation of telephone companies in their own way. These representatives objected to all the Langdon amendments made to the bill which would make it a real utilities commission law. Objection was made to the provisions that all companies should be required to interchange business through switchboard connections and it was urged that a certificate of public necessity be secured from the commission before a competitive company should be allowed to enter the field at any point. Other telephone men present did not insist upon such wholesale elimination of regulation, however. Attorney Cyrus Huling said he believed that corporations are unduly exercised over the prospect of regulations and that it would be better to submit now to the terms of the bill than to get something worse later on, and that it would come to this. Mr. Starbuck Smith, of Cincinnati, who appeared for the people, said that if a law is to be enacted it should be a real utilities measure or nothing. If the original idea is not carried out the statute books would be better off without anything at all in this line. Representatives of express companies, interurban railway companies and some other classes of utilities asked that they be eliminated entirely from the bill. This would leave only the telephone companies.

The Russell bill, which was intended to clear up all objections to interurban railway companies furnishing energy for lighting and industrial purposes in villages that are too small to support independent lighting companies, has been defeated in the Ohio House of Representatives. The fight against the bill was made on the ground that the big companies would drive the little plants out of business by making low rates and then, when they had a clear road, would increase the rates until they became exorbitant. These objections were raised principally because energy is being furnished in larger towns in some instances by railway companies, but the small places may suffer through the defeat of the bill.

New Hampshire Public Service Commission.

The act establishing a public service commission which has been passed by the New Hampshire Legislature is drawn along very broad lines, giving the commission authority over all public utilities, including gas, electric, telephone, telegraph and railroads, both steam and electric, but excepting municipal plants.

The commission is to be composed of three persons, to be appointed by the Governor, a chairman (to be appointed and commissioned as such) at a salary of $3,500, a clerk at $3,200 and a third member at $3,000. The term of one member shall terminate in 1913, the second in 1915 and the third in 1917; the appointments thereafter will be for a term of six years. The Governor and Council may at any time remove a commissioner for inefficiency, neglect of duty or malfeasance in office, but not without a hearing.

The commission is authorized to expend $4,000 annually, and with the approval of the Governor and Council such further sums as may be necessary. It will have power to subpœna witnesses and to compel the production of any books, papers, etc. If any public-utility company refuses or neglects to make such reports as ordered by the commission, or to answer specifically any questions asked, it will be fined $100 for each day until they make such report or answer. For refusal or neglect to comply with an order of the commission the act provides for a fine of not more than $5,000, and for any officer or agent who wilfully violates any of its provisions a fine of not more than $1,000 or six months' imprisonment, or both.

Any public-utility company generating electricity by water-power is prohibited from exporting energy beyond the confines of the State without the approval of the commission, and such approval may be withheld if it can be shown that a market for such energy exists within the State and within a reasonable distance of the development. The commission may impose the condition that consumers within the State shall be furnished with energy on terms as reasonable as granted to those outside the State, having due regard for all facts and conditions which would affect the subject. These provisions, however, are not to affect companies now transmitting energy without the State, except to apply to additions to existing plants, and not to apply to plants on the Connecticut River, nor to railroads within the State transmitting energy for the operation of their own cars without the State.

The law provides that the commission must investigate complaints if made by city councils, mayors or selectmen, or upon the complaint in writing of 100 or more customers or subscribers in cities of 30,000 or more, not less than fifty in cities of 20,000, or not less than twenty-five in all other cities or towns.

When petitioned by a public-utility company the commission may have a hearing, take evidence, and should it decide that the necessity exists may condemn land for extension of plants, pole lines or conduits.

Massachusetts Legislative News.

A resolve has been sent to the Railroad Commission by the Legislature requiring the Board to investigate the traffic conditions at the stations of the Boston Elevated Railway Company and to submit a report upon its findings by the middle of May. The committee on public lighting has sent in an adverse report on the bill accompanying the petition of Mr. W. W. Roberts for legislation authorizing cities or towns to construct municipal gas or electric lighting plants. The bill provides that nothing in it should be construed as compelling the municipality to purchase the plants of existing private companies, and was regarded by the committee as hostile to the best interests of both the public and the electric and gas lighting industries. The committee has also reported leave to withdraw the Morrill bill for municipal plant establishment, which resembled the preceding bill in not requiring compulsory purchase by the city or town, and which also relaxed the present law requiring votes in two successive years in order to establish a plant. At the hearings it was clearly shown that any such legislation would be a reversal of the policy of the State, which protects existing investments from exploitation and unfair competition with the public treasury in return for the supervision exercised by the public utility boards.

Wisconsin Commission News.

Six electric-light companies have been ordered to appear before the Wisconsin Railroad Commission and explain their failure to comply with the rules of electric service. The hearings have been set for April 27, 28 and 29. The commission will shortly carry on an investigation, on its own motion, of the rates and practices of the Southern Wisconsin Power Company and the Green Bay Gas & Electric Company.

The commission issued an order some weeks ago which will result in a reduction of operating revenues by the Racine Gas Light Company to the extent of approximately $13,000 annually. The decision is of interest on account of the many elements of valuation which figure in the case. The petition, which was brought before the commission by the city of Racine, alleges that the rate charged by the Racine Gas company was excessive; that consumers were obliged to use two meters, one for fuel gas and one for illuminating gas, although only one quality of gas was furnished. As the meter rate subsequently ordered was made the same for both fuel and illuminating gas the necessity of a double-meter system no longer existed and it was therefore ordered abolished.

The plant of the company had a cost of reproduction new of $986,290 on June 30, 1910, and this value was assumed by the commission as the basis upon which the company was entitled to earn interest. The bonded indebtedness was considerably greater than this. The valuation claimed by the company exceeded this figure by about $218,663, which included the cost of pavement, the value of property owned but not used by the company, and an allowance for "going value."

The tentative valuation included an item of $27,794 representing the cost of reproduction for paving. However, in line with this opinion an investigation authorized by the commission showed that only $3,444 had actually been expended by the company on account of paving and that no matter how much the reproductive value of the property had been enhanced by reason of pavement laid subsequent to the laying of the mains, the company was entitled to only $3,444 increase in its valuation.

Property valued at $15,370 which was owned by the company but not used by it or necessary in the conduct of its business was not allowed by the commission in fixing the earning value of the property.

The company contended that approximately $179,000 had been expended in building up the business; that, inasmuch as no return had been received on this expenditure, it should be allowed as part of the value of the property upon which the company was entitled to earn interest. It is the view of the commission that going value, if it exists, is a proper element of valuation. But in the present case it developed that a large portion of the $179,000 had been paid out of the earnings as the expense was incurred and the remainder had been charged to the construction account. Upon calculation it was found that if the amounts thus charged to construction had been charged to operating expenses and paid out of the earnings each year, the company's net earnings, after allowing 2 per cent on the total property for depreciation, would have never been less than 7 per cent of the cost of reproduction, taken year by year, and would have reached 9 per cent during the highest year. Consequently to-day the Racine Gas Company has no going value, for the rates in the past have yielded a sufficient revenue to reimburse the company for all business-promotion expenditures and to yield, in addition, a reasonable return upon the investment.

It was contended also by the petitioner in this case that the consumers in Racine were paying interest upon an over-investment. The special investigation carried out by the engineering staff proved the truth of this allegation. The over-investment apparently was not confined to any single portion of the plant. The plant equipment with but few exceptions is far in excess of the present needs of the city and great enough for many years to come.

The net rates previously in force were as follows: Illuminating: Any amount, $1.20 per 1000 cu. ft. Fuel: First 10,000 cu. ft., $1 per 1000 cu. ft.; next 20,000 cu. ft., 80 cents per 1000 cu. ft.; all over 30,000 cu. ft., 60 cents per 1000 cu. ft.

The rates ordered by the commission are as follows: For all gas service, a charge of $1 net or $1.10 gross per 1000 cu. ft. for the first 4000 cu. ft. used during any one month; 80 cents net or 90 cents gross per 1000 cu. ft. for the next 11,000 cu. ft. used per month; 60 cents net or 70 cents gross per 1000 cu. ft. for all gas in excess of 15,000 cu. ft. per month. The minimum bill was graduated according to the size of the meter from 25 cents per month for the three-lamp meter to $4 per month for the 200-lamp meter.

New Jersey Commission News.

A bill which enlarges greatly the powers of the Board of Public Utility Commissioners of New Jersey was passed by the Legislature of New Jersey at its closing session on April 21. Gov. Woodrow Wilson in a statement regarding the legislation enacted at the session said:

"The public-utilities act goes the full length of reform in respect of the control of public-service corporations. It is a thoroughly businesslike act, well conceived and well constructed, and ought to afford a means of settling some of the most perplexing questions connected with the control of corporations."

Prof. Winthrop Moore Daniels has been appointed a member of the commission to succeed Mr. Frank H. Sommer.

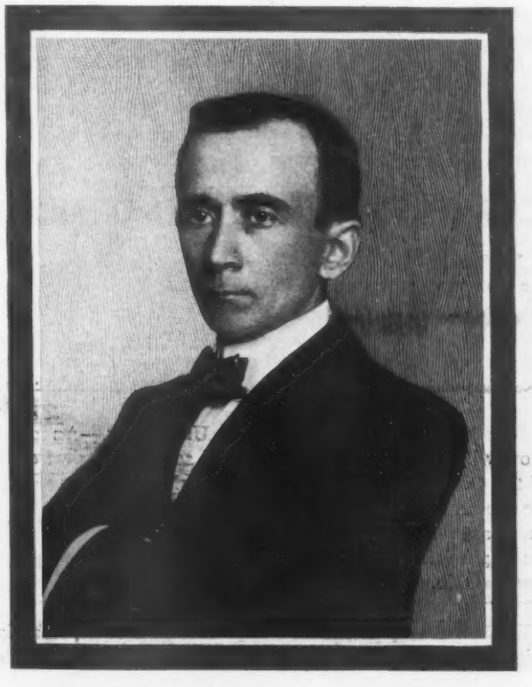
Canadian Hydroelectric Commission News.

The City Council of Toronto at a meeting on April 18 unanimously appointed Mr. P. W. Ellis as its nominee on the commission to manage the city's hydroelectric distribution system. The aldermen who formerly opposed the appointment of Mr. Ellis stated that their action had been taken in view of the position of the city in the negotiations for the purchase of the Toronto Electric Light Company; but now that the latter had been sold to Sir William MacKenzie it is expedient that the city should immediately appoint the commission to manage the city's plant. Mr. W. K. McNaught, M. P. P., who it was expected would be the commissioner appointed by the Hydroelectric Commission, has announced that he will not be able to accept the appointment. The third member will be the Mayor of the city for the time being.

AMERICAN ELECTRICAL ENGINEERS.—XXXI.

J. W. Fraser.

James William Fraser was born in Bridgeville, N. C., March 6, 1874, and after passing through the common and high schools of his native town spent a year at the Pictou Academy, Pictou, N. S. In 1895 he entered McGill University, Montreal, from which he was graduated with the degree of



J. W. Fraser.

Bachelor of Applied Science in 1899, and two years later received the degree of Master of Science, his thesis being "An Original Investigation on the Distribution of Alternating Current in a Conductor." While pursuing the post-graduate course Mr. Fraser was assistant in physics at McGill for one year and assistant in electrical engineering for another year.

After spending somewhat over a year in the shops of the

Westinghouse Electric & Manufacturing Company at East Pittsburgh, Mr. Fraser went with the Shawinigan Water & Power Company, of Canada, with which he remained for a year as constructing engineer. During this time the first 50,000-volt transmission line in Canada was put in service, this being the second line of this voltage in America, that of the Missouri River Power Company antedating it by a few months. In the autumn of 1905 he returned to the Westinghouse Electric & Manufacturing Company as constructing engineer, and in May of the following year he accepted the position of assistant chief engineer with the Southern Power Company, which was then in the course of organization for the larger work which it subsequently undertook. During his connection with that company a plant has been installed having a total capacity of 150,000 kw, including two 24,000-kw, one 18,000-kw, and nineteen 11,000-volt, thirty-two 50,000-volt and twelve 100,000-volt substations and four tie-in stations. One thousand miles of high-tension lines have been constructed, and several hundred additional miles are now under way. Moreover, the hydroelectric system is now being reinforced with three 10,000-hp steam turbine generating stations, one of which is now nearing completion.

The work of Mr. Fraser with the Southern Power Company has been as varied as it has been extensive, including the design and construction of transmission lines of 2200 volts, 11,000 volts, 50,000 volts and 100,000 volts; the design and installation of transformer stations of all capacities from 100 kw to 28,000 kw, and both hydroelectric and steam generating stations. His experience has also extended to other lines not generally included under engineering, involving familiarity with details of standard apparatus and market prices. The ability with which the plant of the Southern Power Company has been designed and constructed is indicated by the continuous favorable experience in operation. With the 100,000-volt lines, for example, there have never been any insulator troubles, which is remarkable when it is considered that there are over 300 miles at that voltage in operation and in a district where lightning is very severe.

Mr. Fraser has contributed to the technical press and to discussions of the American Institute of Electrical Engineers, of which he is a member, and last year (March 24, 1910) contributed an article to these columns entitled "The Distribution System of the Southern Power Company."

CURRENT NEWS AND NOTES.

Legislation in Colorado.—At the mid-week lunch of the Colorado Electric Club in Denver on April 20 Hon. Robert S. Ellison, State representative from El Paso County, Col., spoke on legislative methods and emphasized the growing tendency toward direct legislation in Colorado and other states, and the anti-corporation spirit that prevails throughout the country.

Electrical Show at Ohio State University.—An electrical show will be given by the junior and senior electrical engineers of the Ohio State University on the nights of May 12 and 13 in the electrical engineering laboratory. The enterprise is being undertaken for educational purposes and to bring the work of the engineering department to the attention of the people of central Ohio.

Electric Pumps in Horticulture.—Small cultivators in the neighborhood of Seville, Spain, are rapidly substituting electric motors for the old noria, or endless chain of buckets worked by a mule or bullock, hitherto used for raising water from wells for irrigation purposes. The electric light company at Seville supplies energy over the agricultural zone which extends for some 2 or 3 miles around Seville. Within the first year fifty-six installations were made, aggregating 362 hp.

Electric Equipment of New York Library.—At a meeting of the New York Electrical Society to be held in the Engineering Societies Building on April 28 Mr. Frank A. Pattison will describe the electrical equipment of the New York Public Library. After the meeting the members will visit the library building to inspect the generating equipment, wiring installation, illumination features and motor-driven apparatus, including elevators, book conveyors, ventilating fans, machine tools, printing and binding machinery, etc.

Oil Fuel for Steam Boilers.—At a meeting of the Boston Mechanical Engineers held on April 21 a paper was presented by Mr. B. R. T. Collins on "Oil Fuel for Steam Boilers." A valuable feature of the paper was the presentation of a series of tests made last fall at the Redondon (Cal.) plant of the Pacific Light & Power Company on a 604-hp Babcock & Wilcox boiler equipped with a Hammel furnace and burners. The boiler was in regular service under the usual operating conditions. The oil was obtained from the Los Angeles fields, with a heating value of about 18,300 units. A maximum efficiency of 83.3 per cent was obtained on the tests while running at 109.2 per cent of the builder's rating, and the water evaporated per pound of oil from and at 212 deg. Fahr. corrected for moisture was 15.81 lb. The average efficiency for seven tests was 80.47 per cent, and the average evaporation 15.23 lb.

Pittsburgh A. I. E. E.—The annual banquet of the Pittsburgh Section of the American Institute of Electrical Engineers was held at the Hotel Rittenhouse on April 22. About 185 people were present, of whom about sixty were ladies. Past-president Charles F. Scott acted as the toastmaster. The first speaker was Col. H. G. Proutt, vice-president and general manager of the Union Switch & Signal Company, Swissvale, Pa., who spoke on the engineer of the future. Colonel Proutt was followed by President Dugald C. Jackson, who spoke of the aims, development and work of the Institute. The next speaker, Rabbi J. Leonard Levy, of Pittsburgh, took as his subject "A Word in Due Season." The last speaker was Dr. Robert Kennedy Duncan, of the chairs of industrial chemistry at the University of Kansas and the University of Pittsburgh, whose theme was "Industrial Opportunities."

Milan Municipal Water-Power Plants.—The Commune of Milan, Italy, is building the larger part of the new municipal electric plant, to cost $6,485,000, and embracing five water-power stations in the Alps and one steam-power station in Milan, the commune having adopted a new street illumination system to replace the gas-lighting system now in use. The energy derived from the streams in the Upper Valtelline Alps is conveyed across the country ninety-three miles to Milan. Twenty-seven thousand kilowatts at a tension of 65,000 volts will be developed at first, to be subsequently increased to 50,000 kw at 72,000 volts. The transmission line will be three-phase, and the city figures on furnishing users about 24,400 kw. The project embraces the five following power plants: Grossotto, 20,320 hp; Le Prese, 6510 hp; Tirano, 5210 hp; Mazzo, 4050 hp, and Roasco, 3930 hp. Up to the present work has been confined to the construction of the steam station in Milan and the Grossotto hydroelectric station.

Boston Electric Show.—Active preparations continue to be made for the Boston 1912 Electric Show, which will be held in the Mechanics' Building from Sept. 28 to Oct. 26 inclusive, under the auspices of the Edison Electric Illuminating Company of Boston. The manager of the show is Mr. Herbert W. Moses, of the Edison company, with headquarters at 39 Boylston Street, Boston. The entire building, containing over 100,000 sq. ft. of exhibit floor space, has been leased for the occasion. It has accommodations for over 100,000 visitors at one time. The object of the exhibition is to bring together electrical devices, showing by actual demonstration their adaptability to every kind of business, and to give manufacturers every opportunity to present the merits of their apparatus and to impress upon the public the magnitude of the electrical industry and the readiness with which electric service adapts itself to every condition. The Edison company is undertaking the task to promote the electrical industry and to familiarize the public with the possibilities and economy of electric service.

Manufacturers' Convention.—The sixteenth annual convention of the National Association of Manufacturers will be held at the Waldorf-Astoria Hotel, New York, on May 15, 16 and 17. The president of the association is Mr. John Kirby, Jr., and the secretary Mr. George S. Boudinot. The general offices are at 30 Church Street, New York.

Michigan Electric Convention.—The eighth annual convention of the Michigan Electric Association will be held on board the steamship *Minnesota* from June 19 to 22. The steamer will leave Grand Haven at about 9 p. m. on Monday, June 19, and will visit Sault Ste. Marie before returning to Grand Haven, at about 10:30 a. m. on Thursday. The fare will be $25 for the trip, including berth and meals. The president of the association is Mr. John A. Cavanaugh and the secretary Mr. Herbert Silvester, 18 Washington Boulevard, Detroit.

Divided Cost of Curb Lighting.—In Los Angeles the city pays one-eighth of the cost of the ornamental curb lighting on Hill, Broadway, Spring, Main, Fourth and Fifth Streets. The remaining seven-eighths is paid by the abutting property owners. Some of the city officials assert, however, that the city in reality has paid 35 per cent of the cost of lighting the streets during the present fiscal year, and it is proposed that in consequence the city be relieved from paying any part of the lighting cost during the next fiscal year, beginning July 1.

Improvements in Corona, Cal.—The Corona Electric Light Company, of Corona, Cal., is making some improvements in its transmission and distribution system. The 24-ft. poles on Main Street will be replaced by 35-ft. poles and the transmission line on West Sixth Street will be extended to Vincentia Street and south to Tenth Street to serve the new additions to the city. The high-tension wires will be removed from Railroad Street, leaving only the distribution circuits. Another improvement will be the placing of electric lamps at the intersection of alleys in the business section of the city.

Philadelphia Boulevard Lighting.—Arrangements are being made for installing 190 lamps of the so-called 2000-cp rating, arranged in pairs on either side of the center drive along Southern Boulevard in Philadelphia, and 420 70-cp tungsten lamps on the sides of the service driveways flanking the boulevard. The arc lamps will be placed on ornamental standards similar to those now used along Market and Chestnut Streets, while the incandescent lamps will be installed in single units on 10-ft. poles, each lamp being inclosed in a 16-in. glass globe. It is expected that about $75,000 will be appropriated for the equipments.

Keokuk Dam Construction in Full Swing.—Mississippi River hydroelectric energy for St. Louis from the great dam being constructed across the river at Keokuk, Ia., is now positively promised for delivery in 1913. Financial arrangements for the first 120,000-hp portion of the undertaking are reported to be completed and a large force of engineers, draftsmen and laborers is now at work on the site. The plan involves ultimate developments of 200,000 hp and 300,000 hp, with a 110,000-volt transmission line into St. Louis, 140 miles distant, and a power network furnishing hydroelectric energy to towns surrounding the development.

System Changes at St. Louis.—The Lewis Street Station of the Union Electric Light & Power Company, St. Louis, which was formerly the generating station of the Laclede Power Company, absorbed by the Union company, is now being operated by steam transmitted through a pipe line from the Ashley Street Station, a block distant, all boilers at Lewis Street having been shut down. The installation of a 4000-kw rotary-converter unit, soon to be placed in the Tenth and St. Charles Streets substation of the company, and the addition of further 12,000-kw turbine units to the Ashley Street plant, which now has a total rating of nearly 60,000 kw, will make it possible to close down the Lewis Street plant during ten months in the year, operating it only in the heavy peak season.

Chicago Section, I. E. S.—The monthly meeting of the Chicago Section of the Illuminating Engineering Society was held at noon on April 20 at a restaurant at 422 South Wabash Avenue. Mr. C. R. Gilman, of Milwaukee, read a short paper on "Recent Developments in Train and Car Lighting." There was some discussion. A committee was appointed to draft resolutions of regret at the death of Dr. Henry Gradle, an oculist and a member of the society. The May meeting will probably be held in the new building of the People's Gas Light & Coke Company, South Michigan Avenue and East Adams Street, when Mr. C. A. Luther, illuminating engineer for the company, will describe the lighting of this building. At the June meeting the subject for discussion will be "Daylight Illumination."

Entertainment by Long-Distance Telephone.—Mr. U. N. Bethell, president of the New York Telephone Company, entertained the Cliff Dwellers' Club at his home in Montclair, N. J., on April 10, by means of speeches, music, recitations, etc., which came over the long-distance telephone from points in some cases thousands of miles distant. Performers were stationed at New York, Boston, Asbury Park, Washington, D. C., Detroit, Chicago and Denver. From Chicago Mr. W. D. Nesbit made a regular after-dinner speech and from Detroit Mr. A. S. Hibbard, of the Chicago Telephone Company, sang a song. The feature of the Denver participant was a reading which came over the wires for about 2000 miles with perfect clearness. The talking from Denver was done over a phantom circuit made up of two pairs of loaded No. 8 wires. The event was one of great interest to Mr. Bethell's guests and was an exceptional demonstration of the comparative perfection now achieved by long-distance telephony.

Electrolytic Treatment of Water.—At the recent annual meeting of the Illinois Water Supply Association in Urbana, Ill., Mr. W. B. Bull, of Chicago, read a paper on "A New Method of Chemical Treatment of Water." The author described experiments whereby an electrolytic cell was utilized for the production of caustic soda by an iron dissolving agent, presumably HCl. This agent was introduced into a vessel containing iron shavings and produced an iron coagulant which was fed directly into the water to be treated, the water having previously received the caustic soda so as to insure complete neutralization of any CO_2 which might be present. The electrolytic cell was fed with a continuous stream of brine and fresh water. As the chlorine given off reacts with the water much more quickly in the presence of light, an electric incandescent lamp with a reflector was placed over the cell. Mr Bull declares that the coagulant can be formed by this means at about one-third of the ordinary cost.

Pittsburgh Convention of A. S. M. E.—The local Pittsburgh committee of the American Society of Mechanical Engineers, of which Mr. E. M. Herr is chairman and Mr. Elmer K. Hiles is secretary, having in charge the preparations for the convention of the society, which will be held in Pittsburgh from May 30 to June 2, as noted in our issue for March 16, has nearly completed the work of arranging the program for each day during the meeting. The headquarters will be at the Hotel Schenley. On the evening of Tuesday, May 30, there will be an informal reception in the hotel. Professional sessions will be held in the Carnegie Institute on Wednesday morning and evening, Thursday and Friday morning. In the meantime there will be a number of inspection trips to various industrial plants in the vicinity; a boat excursion for the members and ladies up the Monongahela River, a reception and ball at the Schenley on Thursday evening and, finally, on Friday evening, a smoker and entertainment, given by the Engineers' Society of Western Pennsylvania, in its rooms in the Oliver Building.

Electric Sign for Church.—Trinity Chapel, in West Twenty-fifth Street, New York, just off Broadway, it is announced, will have an electric sign to advertise to all who pass that a chance for prayer and meditation is offered.

Philadelphia Meeting of I. E. S.—At a meeting of the Philadelphia Section of the Illuminating Engineering Society held on April 21 Mr. E. C. Crittenden, of the Bureau of Standards, Washington, D. C., presented a paper entitled "An Experimental Study of Flame Standards."

Institute of Operating Engineers.—At the last meeting of the executive committee of the Institute of Operating Engineers Mr. Herbert E. Collins was elected secretary in place of Mr. M. W. Rice, resigned. Mr. W. P. F. Hill was elected treasurer in place of Mr. Adams Harkness, whose term had expired.

Veto of Nebraska Telephone Merger Bill.—Governor C. H. Aldrich of Nebraska has vetoed House Bill No. 537, generally known as the telephone-merger bill, recently passed by the Legislature of the State. The Governor enumerates eight objections, the first being that the bill aims at the control and monopoly of existing telephone business under one management.

No Redress When State Owns Telephones.—The Association of Telephone Subscribers of Paris, France, was nonsuited in its action for damages against the state for interruption of the telephone service after a fire at one of the big central telephone stations. The court threw the case out on the ground that the state could not be held responsible for any damages caused by the interruption of service.

Co-operation Between City of Chicago and Sanitary District.—A commission of engineers has been appointed to lay out a comprehensive plan for future work in which the city of Chicago and the Sanitary District are interested. It is pointed out that the construction work done by the city and the Sanitary District has oftentimes resulted in unnecessary duplication. The commission of engineers will report its findings to the Council.

Municipal Regulation of Public Utilities Upheld in Missouri.—The Supreme Court of Missouri has sustained the public utilities law in that State which allows municipal corporations to regulate the rates of public-service corporations. The question came up in the case of the Home Telephone Company against the city of Carthage, and on April 11 the Supreme Court overruled a motion for a rehearing in that case, and by doing so upheld the existing law.

Public Control of Street Railways Recommended in Pittsburgh.—In his report to Mayor Magee, after investigating the street-railway conditions in Pittsburgh, Mr. Bion J. Arnold, of Chicago, recommends strongly that there be public control of this utility so as to secure adequate service and at the same time a protected investment for the owners of the street-railway properties. Mr. Arnold recommends that a definite policy be adopted tending to secure comprehensive transportation for the entire Pittsburgh district. The city and the company should co-operate and make mutual concessions in working out the problem, with the end in view of complete public control of the entire transportation situation.

Kansas City Special to N. E. L. A. Convention.—Special-train service is being arranged for from Kansas City to New York by way of Chicago to connect with the Electric Light Special on the Lake Shore for conveying members to the convention of the National Electric Light Association to be held from May 24 to June 2. Persons who are contemplating attending the convention and who will travel by way of Kansas City should correspond with Mr. E. J. Bowers, assistant master of transportation of the N. E. L. A., 1500 Grand Avenue, Kansas City, Mo., who will look after their welfare, make all necessary reservations, arrange for party tickets from Kansas City, etc.

Corrosion of Iron in Concrete.—In the second paragraph on page 827 of our issue for April 6 appears a typographical error where it is stated that "The tests showed that where fresh water is used to moisten the concrete the corrosion per square foot of iron per year is 8 volts and the average amperage of the current applied in the tests ranges from 0.013 lb. to 0.122 lb. for fresh water and from 3.13 lb. to 7.42 lb. for salt water." This sentence should read: "The tests showed that where fresh water is used to moisten the concrete the corrosion per square foot of iron per year, at 8 volts and the average amperage of the current applied in the tests, ranges from 0.014 lb. to 0.122 lb. for fresh water and from 3.13 lb. to 7.42 lb. for salt water."

Lighting of Halls in Apartment Buildings.—There is a city ordinance in Chicago requiring that lights be kept burning in the public hallways of "tenement houses" more than two stories in height. Curiously enough, the law does not specify whose duty it is to keep these hall lights burning. It has been commonly understood, however, that it is the duty of the owner of the building to provide these safeguards. Any person who refuses to comply with the ordinance is subject to a penalty of not less than $10 nor more than $200. The subject has received some attention of late, some tenants complaining that landlords are neglecting to comply with this ordinance. It is suggested that where such violation exists the complainant shall notify the prosecuting attorney of the city.

Philadelphia's Electric Street Lighting.—Chief McLaughlin, of the Electrical Bureau of Philadelphia, in his report shows the overwhelming preponderance of arc lamps maintained by Philadelphia for street lighting as compared with the principal European cities. The report states that Philadelphia has over twice as many arc lamps on its public circuits as New York. The number of arc lamps in use in Philadelphia is 13,258; in New York (including the boroughs of Manhattan and the Bronx), 5500; in Berlin, 1055; in Paris, 1851; in Vienna, 1155; London, 400, and Brussels, 210. During 1910 Chief McLaughlin points out that there were 986 new arc lamps connected. The cost of maintenance in Philadelphia is $94.63 per lamp, and notwithstanding the number of new lamps added the contract for maintaining the city's electric street lamps for 1911 will be practically lower by 5½ per cent than the cost for 1910.

Four Years of Municipal Administration in Chicago.—In his final annual message, delivered April 17, Mr. Busse, the retiring Mayor of Chicago, reviewed the work of his four-year administration. During this period the reconstruction of the surface street-railway lines was begun and is now nearly completed. About 420 miles of street-railway track, costing approximately $50,000 a mile, has been laid, and over 2000 large double-truck cars have been put into service. The city's share of the "net receipts" of the street-railway companies, with accrued interest, received during this four-year period now amounts to $6,109,845. This traction fund may be drawn on for the construction of the proposed passenger subway. Several investigations of the subway problem have been made, and Mr. Bion J. Arnold, chief subway engineer for the city, has prepared general plans for a subway system. Mr. Arnold and his staff are now engaged in developing the engineering details necessary for the carrying out of his recommendations. Mr Busse also gave a brief history of the agitation for the electrification of steam-railroad terminals in Chicago, and said that this is one of the great questions which must be solved before Chicago is many years older.

HYDROELECTRIC DEVELOPMENT IN GEORGIA.

Plant of the Central Georgia Power Company at Lloyd Shoals, Ga.

ONE of the largest hydroelectric installations recently placed in service in the South is the plant of the Central Georgia Power Company at Lloyd Shoals, on the Ocmulgee River, about 8 miles southeast of Jackson, Ga. The market for the energy developed exists largely within the cities of Atlanta and Macon, lying within a radius of from 50 miles to 100 miles of the plant, including also various cotton mills which are being established at isolated points in the neighborhood. The ultimate development possible at Lloyd Shoals consists of a maximum of 25,000 hp and the present installation consists of six 3000-kva generating units direct-driven by waterwheels under a head of 100 ft. Electricity is transmitted to Atlanta and Macon at a potential of 66,000 volts over a double three-phase line carried on steel towers.

The slope of the river bed at the power-house location is abrupt, and at the site of the dam built by the company the valley is extremely narrow. The west bank of the river rises to a height of 120 ft. at a distance of only 150 ft from the edge of the channel. The opposite bank is less steep, although the abutment extends only 600 ft. from the water's edge. A total length of 1700 ft. was sufficient for the closing of the valley and the development of 100-ft. head at the plant site. The dam is a monolithic concrete structure, having a total length of 1050 ft. between abutments, with a 750-ft. spillway extending from the east abutment to a point near the center of the original river channel. The power plant was built between the end of the spillway and the west shore of the stream, the downstream face of the dam forming in part the rear wall of the station. The

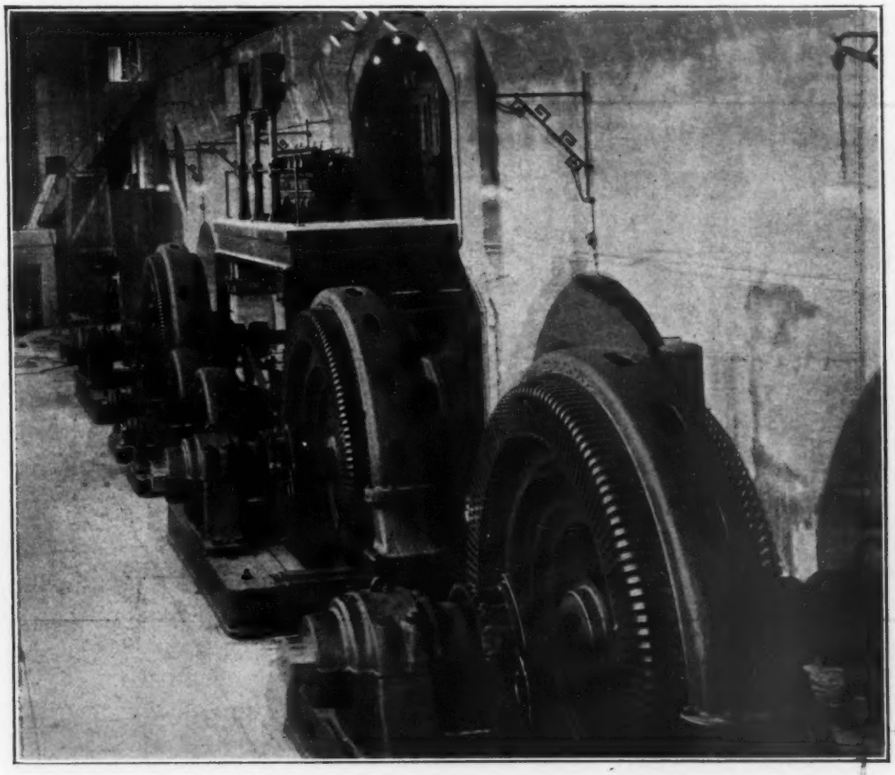


Fig. 1—Generating Room.

location of the plant beneath and at one face of the dam resulted in a simple hydraulic design. The river serves as its own forebay, and no canal, flume or elaborate penstock construction was necessary. Each unit is supplied with water by a short penstock, 12 ft. square, with flattened corners, leading through the dam to the wheelpit of the station, the wheels being of the central-discharge type with short draft-tube connections leading into the tailrace. The draft tubes are elliptical in section and are 11½ ft. x 15 ft. in dimensions at the discharge end. The discharge is carried directly downward from the wheels and deflects into the tailrace by an easy curve at the bottom of the tubes, so that the minimum amount of

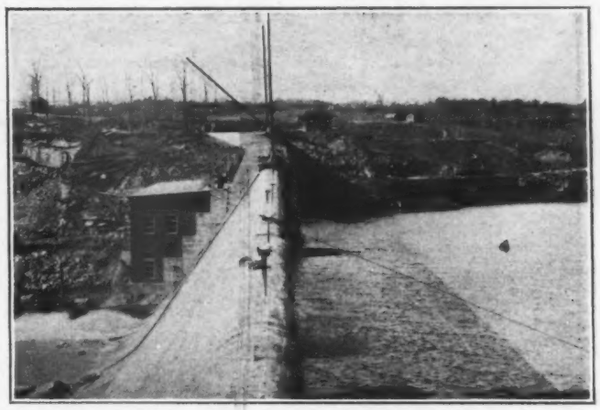


Fig. 2—Dam from East Abutment.

retardation is experienced through friction. The plant illustrates in this particular the tendency of designers to avoid reducing the wheel efficiency by leaving water passages in service where sharp corners or unsatisfactory curves may cause a partial impedance to the flow.

The west end of the power house is completed to the abutment of the dam, as shown in the accompanying photograph, and behind the abutment are located a 125-ft. section of retaining wall and earth embankment 150 ft. long with a concrete core wall. On the east bank is an earth fill 500 ft. long, which is built on a curve carrying it 400 ft. upstream. The foundation was excellent for supporting heavy masonry as both sides of the valley and a large part of the river bottom are of solid gray granite. The site is 6 miles distant from the nearest point on the Southern Railway, and is connected with it by a standard-gage railway built by the contractors for the plant.

The normal width of the river before the building of the dam was about 300 ft., and the ordinary depth 3 ft. to 4 ft., with a velocity of 3 ft. to 5 ft. per second. The average low-water flow approximates 1500 cu. ft. per second. The reservoir created by the dam extends back up the river for a distance of about 14 miles, and immediately above the dam the pondage widens to an extreme width of 1 mile. All the preliminary surveys and gagings of the stream flow, etc., were carried out by Messrs. Lockwood, Greene & Company, of Boston, Mass., who also prepared the plans for the dam and the power house.

The power plant is a brick and steel building 200 ft. x 45 ft., and two stories in height. The outer and division walls are of brick and are 20 in. thick at the first story and 16 in. thick at the upper story. Brick pilasters are provided for traveling-

crane service. The floors and roof are of steel-beam and concrete-slab construction, the roofing being five-ply tar and gravel. The station cornices are of concrete and the windows are of wooden frame, sash and clear-glass construction. The downstream side of the station is on a line with the bed of the dam

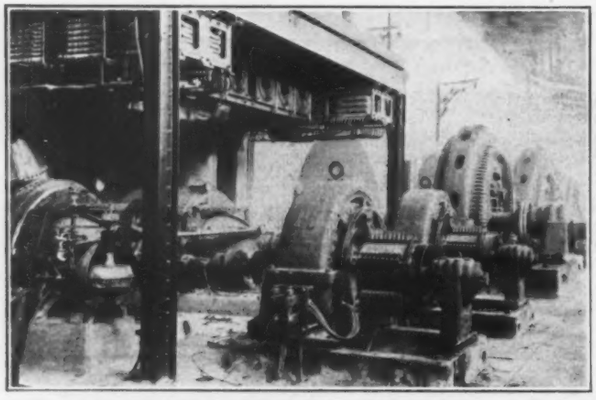


Fig. 3—Exciter and Generators.

and its profile conforms to the slope of the dam. As a result the upper floor is stepped back one bay beyond the lower floor. The basement of the plant is devoted to draft tubes and tailrace discharge outlets, and is of concrete construction throughout. Separate discharge outlets are provided for each hydraulic unit.

The generating equipment of the plant consists of six 3000-kva, 2300-volt, three-phase, 60-cycle alternators, each direct-connected by a horizontal shaft to an S. Morgan Smith waterwheel operated at 300 r.p.m. There are two exciter sets in service, one being driven by a small waterwheel and the other by a motor. The exciters run at 550 r.p.m. and deliver direct current at 250 volts for station lighting as well as for field excitation. The main generating units are of the revolving-field type and all the electrical equipment was supplied by the Westinghouse Electric & Manufacturing Company. Couplings are installed in the generator shafts to facilitate disconnecting the machines from the waterwheels. The waterwheel governors are mounted in a recessed portion of the generator-room wall on the same floor level as the alternators. On the dam side of the building is located a switchboard gallery of concrete construction, the platform being carried on steel posts set into the generator-room floor. The entire operating-room is served by an electrically driven crane with cab for controller equipment. Behind the switchboard is a circular iron staircase leading from the main floor to the gallery and second floor. All the transforming and high-tension equipment of the station is located on the upper floor of the building, where ample space has been provided for safe operation. Power from the generators is carried through cables run in floor ducts to a set of 2300-volt busbars mounted in barriers in a bus compartment located above the switchboard gallery but below the high-tension division of the station. The path of the current is from a generator through the leads to a generator switch, to a bus switch, from thence to the busbars and to a transformer switch, through

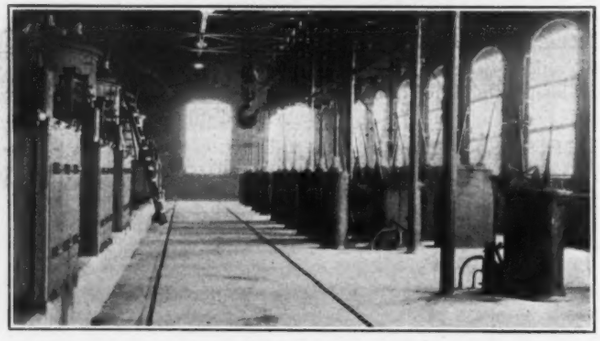


Fig. 5—Switches on High-Tension Floor in Power House.

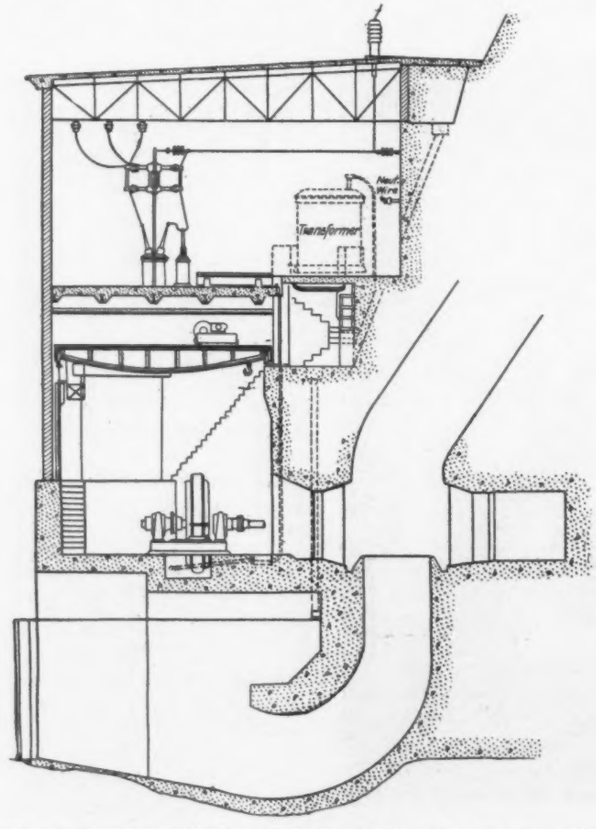


Fig. 4—Transverse Section of Power House, Showing Generator and Turbine Equipment.

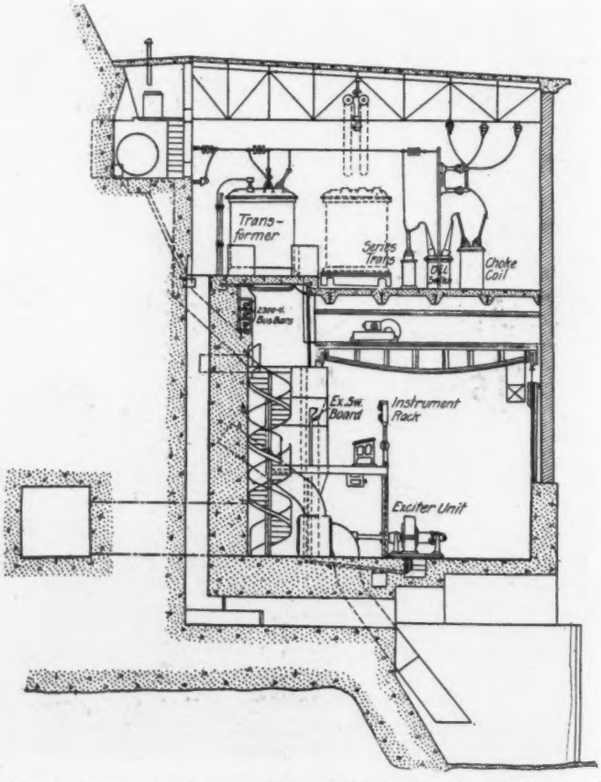


Fig. 6—Transverse Section of Power House, Showing Exciters and Controlling Apparatus.

the primaries of the step-up equipment. From the secondaries the power passes through an outgoing feeder oil switch with series-transformer connections and thence to the high-tension lines Series transformers are installed in the generator leads for use in connection with switchboard instruments and over-

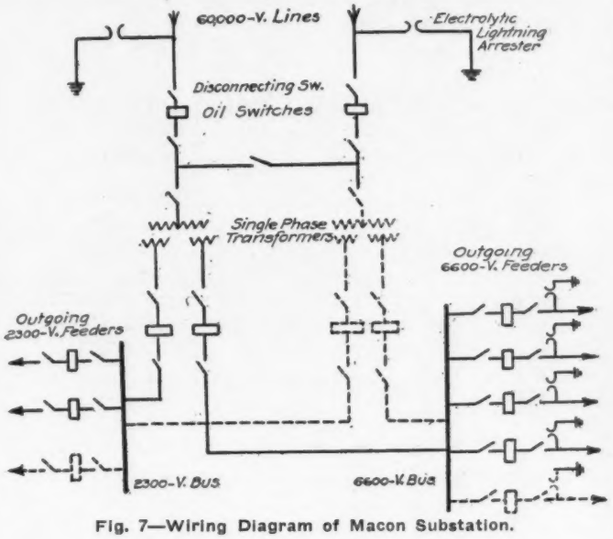


Fig. 7—Wiring Diagram of Macon Substation.

load relays. Each generator is controlled between its terminals and the 2300-volt busbars by a 1200-amp, three-phase Westinghouse oil circuit-breaker. The transformer equipment consists of six 3000-kva units of the three-phase type mounted on the floor of the second story. A chain hoist is provided for lifting out the core windings of any transformer and a transfer track is installed throughout the entire length of the second floor.

Each generator unit is connected to the 2300-volt busbars through a second 1200-amp oil switch, and also to the secondaries of the transformers through a third switch of the same type and size. Disconnecting knife switches are provided in the leads between the generator, the low-tension busbars and the transformer primaries. The connections permit the operation of any generator on any transformer, and the multiple operation of all transformers on the high-tension busbars. Normally each generator is operated on its corresponding transformer. On the secondary sides of the transformers the power is controlled by six 200-amp, three-phase, 66,000-volt oil circuit-breakers, equipped with trip coils operated by series transformers in circuit with the high-tension line. Choke coils are installed in each lead between the high-tension oil switch and the busbar. The low-tension and high-tension busbars are each divided into two sections by bus-junction switches. From each 66,000-volt bus section taps are taken off for the outgoing

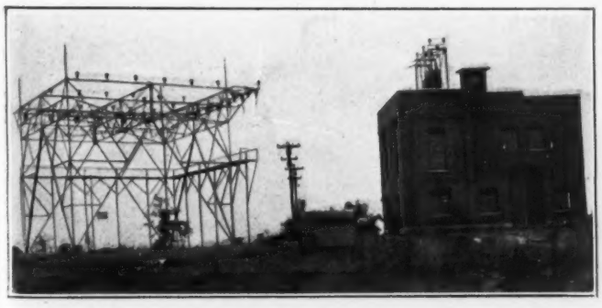


Fig. 8—Substation at Forsyth.

lines. There are two three-phase circuits carried on four-leg steel towers, the insulators being of the upright umbrella type. Each outgoing circuit is equipped with a 200-amp automatic oil switch. Disconnecting switches of the knife-blade type are installed between the choke coils and 66,000-volt busbars in each tap from the transformer secondary coils, and also between the high-tension busbars, the line oil switch, and between the latter and the external circuits. Taps leading to horn-gap and electrolytic lightning arresters are provided at the point of exit of the transmission circuits just outside the station building. The switching arrangements enable either line to be operated on the secondary of any transformer unit. The high-tension transformer primaries are connected in delta and the secondaries in Y, with a grounded neutral point. A steel

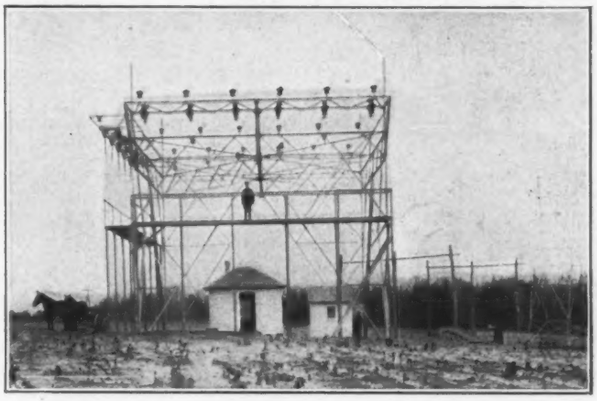


Fig 9—Sectionalizing and Branch-off Tower at Bibb.

ground wire is installed at the top of the transmission-line towers for additional protection against lightning. All busbars in the plant are sectionalized and fed by remote-control switches mounted on a deskboard set on the switchboard gallery. At the front of the deskboard and backed against the operating-room are installed the principal indicating and recording instruments. The alternator-field rheostats are located on the under side of the switchboard gallery and are thus provided with excellent ventilating facilities. The exciters are not controlled on the remote principle, but are connected with switching and indicating apparatus mounted on a special switchboard behind the deskboard.

Among the substations of the system that at Macon is most representative in construction. The same general features of design characterize all these installations. The high-tension lines are dead-ended on insulators carried on elaborate angle-iron framework outside the buildings. At Macon a single floor and basement are in service, the latter extending only half way across the building. The substation is of brick and steel construction, with concrete floors and foundations for the transformers and oil switches. The roof is carried on a light steel

Fig. 10—Substation at Griffin.

truss, the incoming line being carried on a steel tower on the top of the former. Westinghouse electrolytic and horn-gap arresters are installed on the roof. The electrical connections of this substation are shown in the accompanying drawing. The high-tension lines, two in number, are connected with the

arrester equipment outside the building, and thence the power passes through disconnecting switches to high-tension oil switches located on the floor at the side of the station opposite the transformers. Beyond the oil switches in each case are two disconnecting knife switches, between which a bus tie line connects the two incoming circuits, a further disconnecting switch being provided in the tie. Each line then passes to its corresponding transformer primary. At Macon seven transformers are provided for, but only four are installed at present, three being used on one of the lines and a fourth held as a reserve. The transformers are rated at 1500 kw each, and the secondary connections provide for the delivery of 6600-volt and 2300-volt current for local distribution. Each low-tension feeder is provided with a set of disconnecting switches on each side of a central oil switch, which enables the circuit to be isolated in the most convenient manner at any time. Two sets of low-tension busbars are provided, but the busbars are not duplicated for any low-tension voltage, as in the generating station. The 6600-volt lines are protected with electrolytic lightning arresters in the same manner as the 66,000-volt circuits. The low-tension switches and busbars are located in the basement of the substation building. As in the main generating plant, the transformers are provided with a track running the entire length of the building to facilitate their removal in case of emergency. The substation apparatus are located at about the center of the building. Two oil pumps are installed in the substation and an air-compressor and storage-battery equipment are in service, the latter providing energy for the operation of the oil-switch tripping relays.

The work for the Central Georgia Power Company was handled in part by Messrs. J. G. White & Company, Inc., New York, and in part by Messrs. Lockwood, Greene & Company, Boston, Mass. The former firm received the general contract and prepared final detailed plans, while the latter firm acted in a consulting capacity.

ELECTRIC WELDING AND THE FUSING OF METALS.

By A. S. Hatch.

As it is the design of this article to consider incandescent or resistance welding only, since it is the only process which has similar characteristics to the fusing of metals in electrical protecting apparatus, we will first note the method of operation practised in the Thomson process.

The parts to be welded are clamped to the terminals of an alternating-current circuit having a potential on open circuit of from 3 volts to 6 volts. There is only sufficient metal between the clamps to form the weld, usually less than 1 in. except when welding large stock. When the circuit is completed current flows through the abutting metals, heating them to the point of fusion usually in a very few seconds, since in practice it is desirable to make as many welds as possible in a given time rather than to consume the least current. As soon as the proper temperature is secured the operator, applying a pressure of about 5000 lb. per square inch, forces the two pieces together into a perfect weld, the excess metal with the oxides and other impurities being forced outwardly into a fin which is rolled, hammered down or ground off as desired. Such a weld requires no flux, and when it is made at the right temperature without excess heat the joint is nearly as strong as the solid bar. Of a number of tests made at the University of Ohio on welded bars from ⅜ in. to 1 in. in diameter the poorest welds showed a tensile strength of 65 per cent of a solid bar, a majority of the tests showing about 75 per cent and some as high as 85 per cent.

From the above it is clear that the weld is purely the result of the heating effect of the current similar to that produced in an incandescent lamp. Therefore, since incandescent or resistance welding is based on the principle that in an electric circuit resistance generates heat, the weld must be at unity power-factor. In fact, of a number of welds made by the writer, the readings taken at the jaws of the welder showed in no case less than 98 per cent power-factor. However, in order to weld different sizes of stock in the same machine variation of output is obtained by switches or by a reactance coil in the primary circuit. This coil, with the construction of the welder, the shape of the material being welded, the method of compression, the time consumed in completing the weld and other

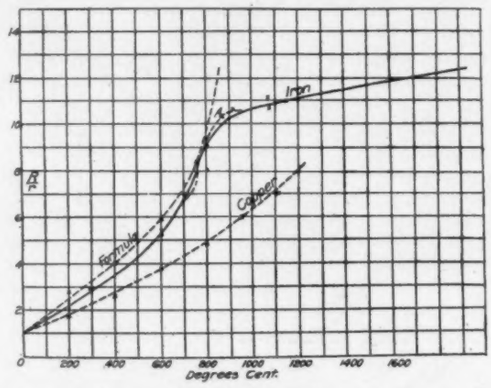


Fig. 1—Variation of Resistance-Ratio with Temperature.

minor conditions, determines the power-factor of the primary circuit. Even such a slight thing as putting the work between the jaws will vary the amperes of the primary circuit.

Since the performance of the welder is judged by the input of the primary current, it is the power-factor which the central-station manager considers when he is applied to for service, and as under the usual mode of operating welders the power-factor is between 50 per cent and 70 per cent rather than between 75 per cent and 95 per cent they are not generally considered a very desirable load for the small station. The factors which enter into the operation to produce such a difference in the power-factors of the primary and secondary circuits are easily divided into two classes, first, those due to the construction of the welder and regulator or choke coil, which includes not only the design for the class of work to be done but also the time in which it is to be done; second, the external factors, which are legion. As an illustration of how simple a thing will affect the power-factor the clamps in a machine were so altered that the work could be reversed, which increased the factor about 10 per cent. A glance at the primary currents given in

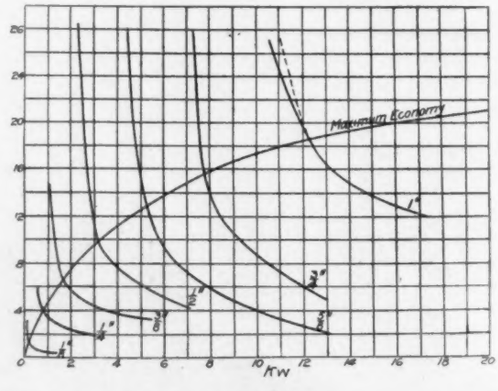


Fig. 2—Relation Between Time and Power in Kilowatts.

Table II shows the variation under seemingly the same conditions, possibly not all a magnetic effect either.

As welding machines are used more for welding iron than probably all other metals combined, it is usually thought the magnetic property of this metal has some effect on the power-factor. The readings of the table contradict such assumption, and further, demagnetization of iron occurs at the temperature of recalescence, 750 deg. C., while the welding temperature is

usually about 1200, so that there can be no reluctance in the weld or produced by the iron during the process of welding. The lowest temperature a good weld can be made at is 1150, and if permitted to heat over 1350 the weld will be burned. Since the weld is at unity power-factor, the ratio of the current to the voltage gives the resistance at the welding temperature. The temperature at the weld is not always the same, since the operator judges the heat by the color of the metal, and in a good weld is considerably below the melting point, but above that of fusion as determined by the formula of Sir William Preece, which is also the same as that of Dr. A. E. Kennelly. In this the element of time is considered as infinite and consequently it gives a minimum value of I, or that required to fuse and not melt the metal. However, in welding the current is higher than that

TABLE I.

Degrees C.	10 Mils.		13 Mils.		16 Mils.		18 Mils.		39 Mils.		1/8 In.	3/8 In.
	Obs.	Est.	Obs.	Est.	Obs.	Est	Obs.	Est.	Obs.	Est.		
15.....	.7	.6	.5	.4	.3	.25	.23	.2	.13	.125	.00045	.000037
200.....	1.5	1.72	1.2	1.15	.76	.72	.54	.57	.....	.....	....	....
290.....	.....	.....	.....	.....	.....	.....	.....	.....	.38	.37	....	....
400.....	2.42	2.44	1.72	1.63	1.0	1.02	.83	.82	.....	.....	....	....
460.....	....	....	....	....	....	....	....	....	.59	.565	....	....
600.....	3.7	3.6	2.4	2.40	1.6	1.5	1.15	1.2	....	....	....	....
700.....	4.8	4.43	3.3	2.95	2.0	1.84	1.55	1.47	.....	.....	....	....
750.....	.....	.....	.....	.....	.....	.....	.....	.....	1.1	1.05	....	....
800.....	5.1	4.86	4.2	3.24	2.4	2.02	1.7	1.62	1.21	1.15	....	....
860.....	....	.....	....	....	....	....	....	....	1.3	1.301	....	....
910.....	6.5	6.27	4.3	4.19	2.8	2.61	2.0	2.08	1.34	1.34	....	....
1,068.....	.....	.....	....	....	.....	.....	.....	.....	1.4	1.4	.....	.....
1,150.....	(Welding heat)		....	....	3.0	2.75	2.1	2.21	....	....	.0054	.000432

TABLE II.

Method of Control.	I_2 by Preece's Formula.	Size of Stock Welded.	Average No. of Welds.	Time in Seconds.	E_1.	I_1.	W_1.	W_1 Sec. Integrated.	E_2.	I_2.	W_2.	W_1 per Square Inch.	Power-Factor Primary	Efficiency.
Non-inductive...	139	¼" round iron	6	1.	220	2.	.372	.370	.8	210	.168	13.8	.84	.46
Reactance coil...		⅜" round iron	5	.98	220	2.2	.412	.410	1.	205	.205	16.7	.85	.50
Switches.....		½" round iron	5	.9	220	2.	.408	.370	1.2	210	.252	20.35	.93	.62
Switches [1].....	393	¼" round iron	8	2.7	220	12.	2.15	5.7	.99	1,960	1.94	39.5	.82	.90
			5	2.8	...	12.8	2.22	6.12	.99	2,040	2.02	41.2	.85	.90
			2	4.	...	10.	1.72	6.75	.98	1,170	1.15	23.4	.79	.67
	723	½" round iron	5	5.	224	13.	2.84	14.	1.	1,645	1.645	33.5	.92	.58
			9	5.27	220	21.9	4.13	21.3	.99	2,190	2.17	19.7	.88	.53
			3	8.93	220	17.3	3.44	30.	1.05	2,490	2.61	23.7	.91	.76
			3	4.	220	40.	6.	24.	1.05	4,330	4.55	41.3	.88	.76
Choke coil.....			20	15.8	85	27.	1.95	30.8	.78	1,800	1.4	13.	.852	.719
			2	3.	220	50.	7.2	21.4	1.1	5,000	5.5	111.5	.655	.76
	1,110	¼" round iron	2	6.2	220	46.	8.13	49.8	1.1	4,970	5.47	27.8	.805	.67
			9	9.6	220	33.3	6.1	58.2	.88	3,860	3.4	17.3	.831	.56
			2	4.	220	76.	14.	56.	1.05	6,680	7.0	35.6	.84	.50
Choke coil.....			20	21.5	100	42.	3.4	73.5	.7	3,400	2.47	12.25	.81	.73
Choke coil.....		⅛" round iron	5	18.	190	71.6	7.66	134.	.....	4,580	.....	.....	.565	.....
Choke coil.....			4	5.1	185.2	106.3	15.15	58.4	.....	6,800	.....	.....	.774	.....
Choke coil.....			3	3.6	180.6	131.5	20.3	61.	.....	8,400	.....	.....	.853	.....
	1,550	⅛" round iron	8	10.85	220	62.6	11.12	120.	1.05	5,510	5.79	18.85	.805	.52
			4	12.5	220	53.5	9.15	112.2	1.	5,140	5.14	16.71	.779	.56
			1	17.	220	53.	9.	149.8	1.	5,730	5.73	18.65	.775	.64
			2	3.5	220	147.	24.5	85.1	1.1	9,400	10.35	33.7	.76	.42
			2	5.	220	115.	16.4	82.1	1.1	8,270	9.1	29.6	.65	.55
			1	9.	220	77.	12.	108.	1.	5,850	5.85	19.	.71	.49
Choke coil.....			3	11.	220	73.6	10.3	112.8	.98	5,880	5.77	18.8	.618	.55
			12	15.	140	75.	8.5	127.	1.05	5,900	5.8	18.3	.808	.69
	2,024	¼" round iron	7	11.6	220	98.5	18.8	214.	1.19	7,100	8.49	19.2	.814	.45
			12	16.4	220	85.3	15.6	251.4	.91	6,480	7.71	17.5	.811	.495
			2	7.	220	160.	28.	190.	1.17	9,600	11.23	25.45	.735	.40
			1	4.	220	170.	27.4	108.	1.20	10,900	13.1	29.7	.73	.47
			1	17.	220	100.	16.	267.	1.00	7,600	7.6	17.2	.73	.47
			10	22.2	160	90.	11.3	250.	1.13	6,450	7.16	16.26	.785	.633
	2,570	⅜" round iron	1	7.	220	270.	43.	298.	1.4	11,900	16.67	27.7	.76	.39
			..	9.	220	250.	40.	353.	1.20	12,000	14.4	24.	.78	.36
			..	12.	220	175.	27.5	324.	1.16	9,800	11.38	18.9	.75	.40
			..	17.	220	165.	23.	384.	1.12	10,550	11.8	19.6	.635	.515
	3,148	1" round iron	2	23.75	220	155.	25.1	583.	1.25	8,670	10.82	13.8	.726	.43
			1	33.	220	121.	19.4	627.	1.05	7,740	8.14	10.35	.73	.42
			6	17.4	220	172.4	28.2	481.3	1.34	9,450	12.66	16.1	.75	.45
		1¼" r'd iron	5	18.3	220	234.6	44.7	799.2	1.45	12,900	18.7	15.8	.87	.42
		1½" r'd iron	5	17.	220	463.	67.2	1115.4	1.5	25,400	38.1	21.6	.66	.57
Choke coil.....		8½"x⅜" flat	3	25.	138	800.	80.	1934.3	1.5	40,000	60.	20.	.73	.75
Choke coil.....		11"x⅜" flat	4	30.	196	800.	140.	4082.5	1.4	82,000	115.	20.9	.89	.82
See Footnote 2		¼" round iron	10	1.	220	.96	.200	.195	.76	210	.160	13.	.95	.80
		⅜" round iron	10	3.	220	4.2	.825	2.55	.8	875	.700	14.	.945	.85
		½" round iron	10	7.	220	9.6	1.9	12.5	.83	1,900	1.6	14.5	.945	.85
		¼" round iron	10	10.	220	17.	3.5	34.	.88	3,500	3.0	15.25	.945	.85
		⅜" round iron	10	12.	220	30.7	6.35	75.	.9	6,200	5.5	17.8	.94	.86
		½" round iron	10	15.	220	41.	8.3	121.	1.	7,300	7.2	16.3	.925	.87
		1" round iron	5	20.	220	87.	17.2	340.	1.1	13,800	15.0	19.1	.90	.86
		1½" r'd iron	5	40.	220	240.	47.5	1150.	1.3	31,400	40.5	23.	.90	.85

[1] Welder designed for these sizes of stock.
[2] These three machines were designed for these tests, and the proportions were based on the data of Table I.

necessary, as it is desired to bring the metal to a welding heat quickly. Many fuses blow because they are too soft to support their own weight and not because they melt. It is this factor which gave open fuses the name of being unreliable, while the reason was more often that the composition or the dimensions, or both, had given the margin observed.

In 1890 the writer while designing some street-car heaters made a series of tests for resistance and temperature, particularly between the points of recalescence and fusing. These, together with one published in the *Electrical World* of April 19, 1890, are tabulated in Table I as the observed readings, while the estimated resistances are based on the published resistances of those sizes of wire and determined by the formula $R = r(1 + 7\,t \times 10^{-3} - 2\,t^2 \times 10^{-6} + 7\,t^3 \times 10^{-9})$. The averages observed and the estimated resistances are quite close up to the critical point of iron, 855 deg. C., with the exception of a slight excess at recalescence. From 855 deg. to the fusing point we have an entirely different curve, it being even less than that produced by the formula for platinum-silver alloy, $R = r\,(1 + 0.00031\,t)$. Fig. 1 shows curves plotted from the ratios of resistance at the given temperature to its resistance at the temperature of the surrounding air.

The temperature in Table I corresponding to welding heat is so called from the color, it being between a bright yellow and a dark white, and not because it was a welding heat at the time of the test.

In Fig. 1 that part of the curve above recalescence or the critical point, marked *a*, has not been studied very much for a comparison of resistance with temperature. A properly constructed welding machine affords an ideal method for such study. In fact, there is no other means by which accurate readings can be secured with very slight changes in temperature, and a small change in this section of the curve can produce a material error in the resistance due to the critical points of iron and steel. As the two retardations producing these points of flexure are about 30 deg. apart, the one which occurs in heating being the higher, a reversal, either lowering during a heating test or raising during a cooling one, will not give correct readings unless the critical points are passed and the readings repeated. Table I also indicates that the commonly accepted formula for iron, $R = r\,(1 + 0.006\,t)$, is too low, and even the formula suggested above is low in the upper part of the curve—that is, for the temperatures just preceding the point of recalescence. The resistance cold of the ⅛-in. and ⅜-in. round iron is estimated, but the resistance at welding heat is taken from the averages of the readings at the jaws of the machine.

As all the above heating tests were made with wire of small diameter it is interesting to note how closely the welding readings of the small rods agree with the small wires in the total rise in resistance. These comparisons confirm the conclusions arrived at in the second paragraph; furthermore, we should expect the watt-seconds per square inch to be quite constant, being varied only by the difference in radiation and conduction, and also that there is a time element where the watt-seconds are a minimum. This point should be with the highest power-factor—that is, with the lowest current. Again, since welding is at unity power-factor the shape of the cross-section, whether round, square or rectangular, should make no difference in the power consumed except for the difference in radiation and conduction. Table II is compiled from a number of welds made on different machines, with different methods of control, in different lengths of time, for the same cross-section, with different degrees of temperature at the point of welding and with different operators. For comparison there are inserted data taken from the published records on welding. As assumed above, the kilowatts at the clamps with the smaller sizes of stock increase quite closely with those of the cross-section, confirming the assumption made, and with the larger sizes the increase is less marked in the tests made on the experimental welder than with one having heavy inductance in the primary circuit. For this reason the most interesting curve in Fig. 2 is probably that of the kilowatts at the jaws as plotted to the time in seconds. The true or ideal curve is a conic section, consequently there is a point in the time of welding when the power consumed is a minimum and has the least effect on the potential of the supplying circuit. We thus see how easily wide variations are secured in tests made with only slight changes in the operation or in the construction of the machine, thereby illustrating the importance of the factors giving the highest power-factor as shown above. Again, a welder to give the most efficient results must be so designed that it can be adjusted for the work to be done when different classes of work are to be performed on the same machine. The common nomenclature is used in Table II, *E* for volts, *I* for amperes, *W* for kilowatts, the subscripts 1 and 2 referring to primary and secondary respectively.

So far iron is the only metal that has been considered, but all the commercial metals have been welded. The characteristics of the other metals—better electrical conductivity, less tensile strength, and generally with a melting point lower than that of iron—give quite different readings. The method of operation is entirely different from that of iron, so much so that the welding of some shapes of the softer metals has been thought by some to be impossible. The formulas for the increase in resistance with the increase in temperature of nearly all the other metals agree closely with the results determined in the higher temperatures, and consequently the curves are much sharper, thus necessarily requiring a different method of welding. Copper on account of its higher melting point is easier to weld than some of the other metals.

LOSSES IN SINGLE-PHASE ROTORS.—II.

Rotors of the Coil-Wound Type.

By H. Weichsel.

In connection with the derivation of the losses in rotors of the squirrel-cage type, as given in the issue of the *Electrical World* for April 20, it should prove of considerable interest to determine in a similar manner the losses in a wound rotor, such as is represented in Fig 2. In order to make a comparison of the two cases on the same basis it must be assumed in this instance that the stator main field has a triangular space distribution, but the same number of lines as in the first instance. In other words, the stator main field must exactly equal the field set up by the rotor, which in the case of an entirely distributed winding is triangular in shape.

The e.m.f. across the brushes *b*-*b'* due to rotation at synchronism will be equal to

$$E_b = z\,P\,N_0\,\frac{n}{60\,\sqrt{2}} \quad \text{(for parallel rotor winding)},$$

where

$$n = r.p.m. = \frac{120\,V}{P}$$

Substituting in the above equation, there is obtained

$$E_b = z\,N_0\,V\,\sqrt{2}$$

This e.m.f. across the brushes *b*-*b'* must be counterbalanced by a field N_b which by induction produces an e.m.f. equal in magnitude, but opposite in direction. Therefore,

$$E_b = 2.22\,g\,z\,N_b\,V_1$$

In this equation g is a coefficient depending on the rotor winding distribution. For the special case we are considering

$$g = 0.666$$

and

$$E_b = 1.48\,z\,N_b\,V_1$$

From these two equations for E_b the number of lines in the cross-field is found to be

$$N_b = \frac{E_b}{1.48\,z\,V_1} = \frac{z\,N_0\,V\,\sqrt{2}}{1.48\,V_1\,z} = 0.955\,N_0\,\frac{V}{V_1}$$

The magnetizing current necessary to produce this field is found by the following equations:

$$N_b = \frac{k\,i\,z}{Q}$$

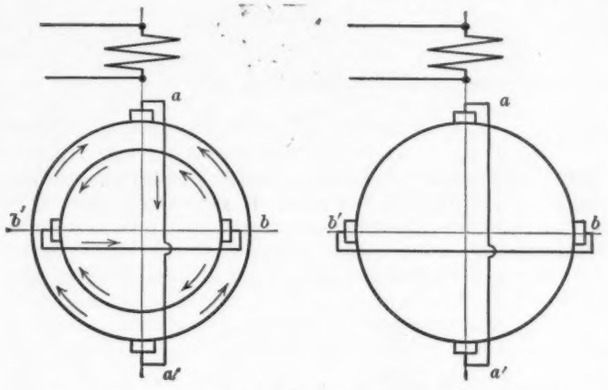
$k = 0.445$ for distributed winding.

$Q = \frac{\delta}{\tau\,l}$ = reluctance of air-gap.

$$i = \frac{\delta\,N_b}{\tau\,l\,z\,0.445} = \frac{i}{\sqrt{2}}$$

$$i = 3.18\,\frac{\delta\,N_b}{\tau\,l\,z} = 3.04\,\frac{\delta\,N_o}{\tau\,l\,z}$$

The value of the rotor-working current in this type of motor may be derived in a way very similar to that used for the



Figs. 1 and 2—Equivalent Circuits of Single-Phase Rotor.

squirrel-cage rotor. The relation between the rotor field and the space distribution of the rotor-working current is shown graphically in Fig. 3. It is evident that the torque of one conductor located γ degrees from axis a-a' can be expressed as

$$T_q = k\,l\,B_\gamma \sin(\omega t)\,I \sin(\omega t)$$

From the relation of similar triangles it is known that

$$\frac{B_\gamma}{\gamma} = \frac{B_o}{\frac{\pi}{2}}$$

and

$$B_\gamma = \frac{2\,B_o\,\gamma}{\pi}$$

Substituting this value in the equation for torque,

$$T_q = \frac{2}{\pi}\,k\,l\,B_o\,\gamma\,I \sin^2(\omega t)$$

The average torque acting on one conductor is

$$T_q = \frac{2}{\pi}\,k\,l\,B_o\,\gamma\,I\,\frac{1}{\pi}\int_o^\pi \sin^2(\omega t)\,dt$$

$$= \frac{k\,l\,B_o\,\gamma\,I}{\pi}$$

The arc occupied by one conductor is $\frac{\pi}{z}$ and, therefore, the torque produced by all the conductors per pole is

$$T_q = \frac{2\,k\,l\,B_o\,I}{\pi}\int_o^{\frac{\pi}{2}} \frac{\gamma\,d\gamma}{\frac{\pi}{z}} = \frac{2}{\pi^2}\,k\,z\,l\,B_o\,I\left[\frac{\gamma^2}{2}\right]_0^{\frac{\pi}{2}}$$

$$= \frac{k\,z\,l\,B_o\,I}{4}$$

Referring to Fig. 3, it will be seen that

$$N_b = \frac{B_o\,l\,\tau}{2} = 0.955\,N_o$$

and

$$B_o = 1.91\,\frac{N_o}{l\,\tau}$$

Substituting in the equation for torque, there is obtained

$$T_q = \frac{1.91\,k\,z\,N_o\,I}{4\,\tau}$$

$$I = \frac{2.09\,T_q\,\tau}{k\,z\,N_o}$$

The copper losses due to the magnetizing current may be expressed as

$$P_{cm} = \frac{i^2}{2}\,r\,z = 4.62\,\frac{\delta^2\,N_o^2\,r}{\tau^2\,l^2\,z}$$

and the copper losses due to the working current are

$$P_{cw} = \frac{I^2}{2}\,r\,z = 2.18\,\frac{T_q^2\,\tau^2\,r}{k^2\,N_o^2\,z}$$

There can now be obtained a comparison between the secondary copper losses in the wound-rotor and squirrel-cage types based on equal torques. The losses due to the magnetizing current are

$$P_{cw}\ \text{(squirrel-cage)} = 3.855\,\frac{\delta^2\,N_o^2\,r}{\tau^2\,l^2\,z}$$

$$P_{cm}\ \text{(wound rotor)} = 4.62\,\frac{\delta^2\,N_o^2\,r}{\tau^2\,l^2\,z}$$

Due to the magnetizing current, therefore, the wound rotor has $\frac{4.62}{3.855} = 1.2$ times the losses that the squirrel-cage motor has. The losses due to the working current are

$$P_{cw}\ \text{(squirrel-cage)} = 1.625\,\frac{T_q^2\,\tau^2\,r}{k^2\,N_o^2\,z}$$

$$P_{cw}\ \text{(wound rotor)} = 2.18\,\frac{T_q^2\,\tau^2\,r}{k^2\,N_o^2\,z}$$

Due to the working current, the wound rotor has $\frac{2.18}{1.625} =$ 1.34 times the losses that the squirrel-cage motor has. These results show the very important fact that for equal torques the wound rotor with commutator and two brushes per pole has from 20 per cent to 34 per cent more losses than the squirrel-cage motor, assuming the same number of conductors and the same resistance per conductor, or (which means the same thing) the same weight of copper, not considering the free ends of the wound rotor or the resistance rings of the squirrel-cage rotor.

The formulas just derived enable one to determine the rotor copper losses for any given torque. However, in the design and testing of single-phase induction motors it is often necessary to determine the rotor copper losses as a function of the slip. In the case of the polyphase induction motor the function is a simple one and may be expressed as follows:

$$\frac{P_o}{O} = \frac{s}{1-s}$$

P_o = watts copper loss in rotor,
O = watts output of rotor,
s = slip.

For small values of slip it is sufficiently accurate to say that the copper losses are proportional to the slip in the polyphase motor. In the single-phase motor, however, the relation is somewhat more complicated, because one must consider separately the losses due to the rotor-magnetizing current and those due to the working current. It is evident that the first-mentioned losses decrease with the slip, while the latter increase with the slip.

Assuming sine-shape space distribution of stator and rotor currents, it can be said that the e.m.f. induced across a-a' by transformation, minus the e.m.f. generated across these points

by rotation, must be equal to the impedance drop, as shown diagrammatically in Fig. 4. Here it is seen that

$$(E_{Ta}-E_{Ra})^2=I^2R^2+I^2\omega^2L^2$$

$$E_{Ta}-E_{Ra}=I\sqrt{R^2+\omega^2L^2}$$

Where E_{Ta} represents the e.m.f. due to transformation in the axis a-a' and E_{Ra} is the e.m.f. due to the rotation in the same axis. R is the ohmic resistance in the axis a-a' and ωL is the

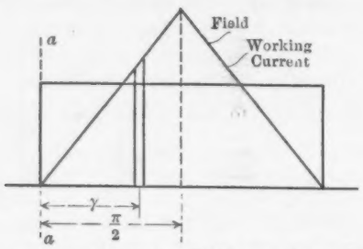


Fig. 3—Relation Between Rotor Field and Space Distribution of the Rotor-Working Current.

apparent leakage reactance in axis a-a'. The output of any motor may be expressed as

$$O=E_{Ra}I\cos\alpha$$

$$\cos\alpha=\frac{IR}{E_{Ta}-E_{Ra}}\quad\text{(see Fig. 4)}$$

$$O=\frac{I^2RE_{Ra}}{E_{Ta}-E_{Ra}}$$

Since I^2R is the total rotor copper loss, the above equation may be written

$$\frac{P_c}{O}=\frac{E_{Ta}-E_{Ra}}{E_{Ra}}$$

This equation is strictly correct even for a motor with leakage reactance. The only assumption made is that E_{Ta} and E_{Ra} are in time-phase opposition to each other. It is known further that the e.m.f. due to transformation can be expressed as

$$E_{Ta}=2.22\,g_a\,z\,V\,N_0$$

$$=2.22\,g_a\,z\,N_0\frac{n_0P}{120}$$

where

$$n_0=\frac{120\,V}{P}$$

And the e.m.f. due to rotation equals

$$E_{Ra}=N_b\,z\frac{n\,P}{60\sqrt{2}}$$

In the axis b-b' the e.m.f. of rotation is

$$E_{\ b}=N_0\,z\frac{n\,P}{60\sqrt{2}}$$

This e.m.f. must be counterbalanced by the e.m.f. produced by the lines N_b in axis b-b'. Therefore,

$$E_{Rb}=2.22\,g_b\,z\,V\,N_b=2.22\,g_b\,z\,N_b\frac{n_0P}{120}$$

$$2.22\,g_b\,z\,N_b\frac{n_0P}{120}=\frac{N_0\,z\,n\,P}{60\sqrt{2}}$$

$$N_b=\frac{\sqrt{2}\,N_0\,n}{2.22\,g_b\,n_0}$$

This substituted in equation for E_{Ra} gives:

$$E_{Ra}=\frac{N_0\,z\,n^2\,P}{60\times2.22n_0\,g_b}$$

The values of E_{Ta} and E_{Ra} may now be substituted in the expression for rotor copper losses:

$$\frac{P_c}{O}=\frac{2.22\,g_a\,z\,N_0\,\dfrac{n_0P}{120}-\dfrac{N_0\,z\,n^2\,P}{60\times2.22\,n_0\,g_b}}{\dfrac{N_0\,z\,n^2\,P}{60\times2.22\,n_0\,g_b}}$$

$$=\frac{2.46\,g_a\,g_b\,n_0^2-n^2}{n^2}$$

Let $n=n_0(1-s)$

Then

$$\frac{P_c}{O}=\frac{2.46\,g_a\,g_b\,n_0^2-n_0^2(1-s)^2}{n_0^2(1-s)^2}$$

$$=\frac{2.46\,g_a\,g_b-(1-s)^2}{(1-s)^2}$$

This equation is true regardless of the winding distribution of stator and rotor, but assuming that the e.m.f. of total self-induction in axis b-b' fully counterbalances the e.m.f. of rotation appearing in this axis. This means that the ohmic resistance drop is small compared to the reactance drop.

If the assumption be made of a sine-shape space distribution of stator field and a squirrel-cage rotor, it will be found that $2.46\,g_a\,g_b=1$. For any other distribution of winding this coefficient will differ slightly from unity. In the case assumed, however, the final result obtained is

$$\frac{P_c}{O}=\frac{2s-s^2}{(1-s)^2}$$

For small values of slip s^2 is negligible and

$$\frac{P_c}{O}=\frac{2s}{1-2s}$$

This equation gives the secondary copper loss for the working current, I, when the slip is known. In some cases, however, it may be more convenient to determine the slip loss as a function of the loss at zero speed.

At standstill the current in axis a-a' is determined by the equation

$$I_k=\frac{E_{Ta}}{\sqrt{\omega^2L^2+R^2}}$$

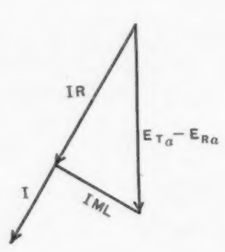
and the corresponding copper loss is

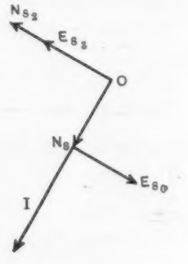
$$P_{ck}=I_k^2R=\frac{E_{Ta}\,I_kR}{\sqrt{\omega^2L^2+R^2}}$$

At any other speed the copper loss is

$$P_c=\frac{(E_{Ta}-E_{Ra})\,IR}{\sqrt{\omega^2L^2C^2+R^2}}$$

At any given slip the e.m.f. of rotation producing current in the axis a-a' has the following relation to the e.m.f. of trans-





Figs. 4 and 5—Relative Time-Phase Position of Currents and Voltages.

formation if a sine-shape of space distribution of the field be assumed.

$$E_{Ra}=E_{Ta}(1-s)^2$$

Therefore,

$$P_c=\frac{E_{Ta}[1-(1-s)^2]\,IR}{\sqrt{\omega^2L^2C^2+R^2}}$$

$$=\frac{E_{Ta}(2s-s^2)\,IR}{\sqrt{\omega^2L^2C^2+R^2}}$$

Dividing this equation by the equation for copper loss at standstill,

$$\frac{P_c}{P_{ck}}=\frac{I(2s-s^2)\sqrt{\omega^2L+R^2}}{I_k\sqrt{\omega^2L^2C^2+R^2}}$$

This equation is strictly correct only on the assumption that

the stator is without leakage or ohmic resistance, and that the e.m.fs. E_a and $E_{a'}$ are directly in time-phase opposition. This latter condition will be very nearly true for a rotor with small ohmic resistance and small magnetic reluctance in axis b-b', as, under these assumptions, the e.m.f. E_{Rb} which appears in axis b-b' will produce a field which is practically 90 time-degrees displaced from it. The e.m.f. E_a produced by rotation in this field must, therefore, be very nearly in time-phase with the e.m.f. of transformation E_{Ta}.

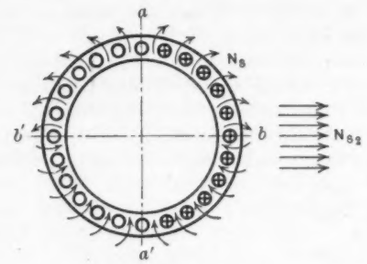


Fig. 6—Leakage Fields.

In the equation for Pc is introduced the factor C, which should indicate that the e.m.f. of leakage self-induction changes with the speed, as has been shown by Mr. Val. A. Fynn in the *Proceedings* of the (British) Institution of Electrical Engineers, December, 1907. In the following the value of the factor C will be determined. Referring to Fig. 5, let OI represent the secondary current. This will produce a magnetic leakage field N_s around the armature rotor conductor, as indicated in Fig. 6. These lines produce the leakage reactance voltage.

$$E_{so} = I\,\omega\,L = 2.22\,k\,z\,N_s\,V \times 10^{-8}$$

and at the same time produce an e.m.f. of rotation across the brushes b-b'. If these brushes are short-circuited the resulting current will set up a magnetic field N_{s_2} in the direction of the brushes b-b'. This field must be 90 time-degrees displaced from the rotor current, as shown in Fig. 5. Due to rotation in this field, an e.m.f. E_{s_2} will appear in axis a-a', and it is readily seen

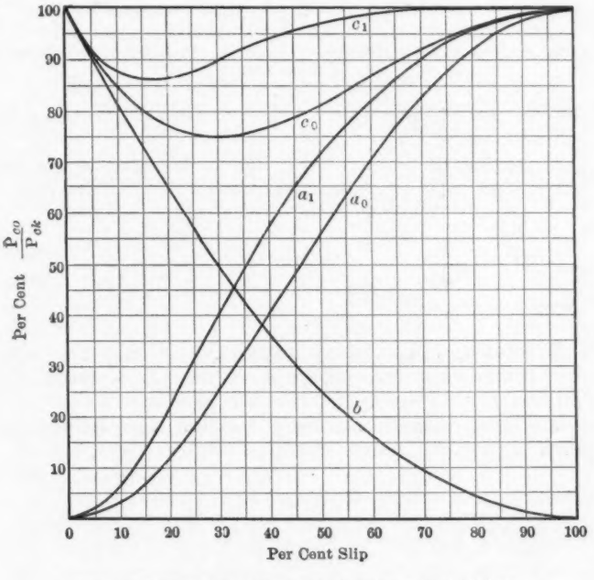


Fig. 7—Computed Losses at Various Slip Values.

that this e.m.f. opposes the e.m.f. of self-induction E_{so}. At synchronism these two e.m.fs. E_{so} and E_{s_2} will be equal and annul each other. At standstill the e.m.f. of rotation, E_{s_2}, will be zero, and at any other speed it will be proportional to the square of the speed.

$$E_{s_2} = (1-s)^2\,E_{so} = (1-s)^2\,I\,\omega\,L$$

The leakage reactance voltage which remains is given by the expression

$$E_s = (E_{so} - E_{s_2}) = [1-(1-s)^2]\,E_{so} = (2s-s^2)\,E_{so} = I\,\omega\,L\,C$$

and

$$C = (2s-s^2)$$

Substituting in the equation for $\frac{P_c}{P_{ck}}$ the values of C, I and I_k, where

$$I = \frac{E_{Ta} - E_{Ra}}{\sqrt{\omega^2 L^2 C^2 + R^2}} = \frac{E_{Ta}\,(2s-s^2)}{\sqrt{\omega^2 L^2 (2s-s^2)^2 + R^2}}$$

and

$$I_k = \frac{E_a}{\sqrt{\omega^2 L^2 + R^2}},$$

there is obtained,

$$\frac{P_c}{P_{ck}} = \frac{(2s-s^2)\,\sqrt{\omega^2 L^2 + R^2}\,(2s-s^2)\,\sqrt{\omega^2 L^2 + R^2}}{\sqrt{\omega^2 L^2 (2s-s^2)^2 + R^2}\,\sqrt{\omega^2 L^2 (2s-s^2)^2 + R^2}} = \frac{(2s-s^2)^2\,(\omega^2 L^2 + R^2)}{\omega^2 L^2 (2s-s^2)^2 + R^2}$$

and if, further, $\frac{\omega L}{R} = a$ the above equation can be expressed as

$$\frac{P_c}{P_{ck}} = \frac{(2s-s^2)^2\,(a^2+1)}{a^2\,(2s-s^2)^2 + 1}$$

When the leakage self-induction is small in comparison with the ohmic drop, that is, when a approaches zero in value,

$$\frac{P_c}{P_{ck}} = (2s-s^2)^2$$

This equation is graphically represented by curve a_0 in Fig. 7. This curve shows that the slip losses (copper losses) due to working current increase nearly proportionally to the square of the slip for small values of slip. For slip values above 40 per cent (approximately) the losses increase less rapidly.

Curve a_1, Fig. 7, represents the same equation, but under the assumption that $a = 1$; that is, that the rotor current at standstill has a time-phase displacement of 45 deg. against the e.m.f. E_a.

In a similar way the rotor copper losses due to currents in axis b-b' can be expressed. In this case, however, it is more convenient to express the slip losses as a function of the losses occurring at synchronism. Assuming, as in the first case, that the field has sine-shaped space distribution, the current in axis b-b' at synchronism is given by the expression

$$i_0 = \frac{E_{Rb}}{\sqrt{\omega^2 L_b^2 + R^2}} = \frac{E_{Ta}}{\sqrt{\omega^2 L_b^2 + R^2}}$$

where L_b is the total self-induction (including leakage self-induction) in axis b-b'.

At any other speed,

$$i = \frac{E_{Ta}\,(1-s)}{\sqrt{\omega^2 L^2 b + R^2}}$$

and the ratio of losses due to currents in axis b-b' occurring at any given speed to the losses occurring at synchronism is given by the expression

$$\frac{P_c}{P_{co}} = \left(\frac{i}{i_0}\right)^2 = (1-s)^2$$

This equation has been graphically represented by curve b, Fig. 7. The total losses due to working current and magnetizing current are represented by curves c_0 and c_1, for the cases of zero leakage reactance, and for leakage reactance equal to resistance, respectively. Both of these curves show that there is a certain slip where the armature copper losses reach a minimum.

The total rotor copper losses may be represented by the equation

$$P_c = P_{co}(1-s)^2 + P_{ck}\frac{(2s-s^2)^2(a^2+1)}{a^2(2s-s^2)^2+1}$$

This value reaches a minimum for the speed determined by

$$\frac{dP_c}{ds}=0$$

The first part of the equation is easily differentiated.

$$\frac{dP_{co}(1-s)^2}{ds}=P_{co}(2s-2)$$

For differentiating the second part there may be written,

$$2s-s^2=x \text{ and } P_{ck}(a^2+1)=A$$

Then

$$\frac{P_{ck}(2s-s^2)^2(a^2+1)}{a^2(2s-s^2)^2+1}=\frac{x^2A}{a^2x^2+1}=\frac{U}{V}$$

$$\frac{d\frac{U}{V}}{dx}=\frac{V\frac{dU}{dx}-U\frac{dV}{dx}}{V^2}$$

$$U=Ax^2, \qquad \frac{dU}{dx}=2Ax$$

$$V=a^2x^2+1, \quad \frac{dV}{dx}=2a^2x$$

Substituting the above values,

$$\frac{d\frac{U}{V}}{dx}=\frac{2Ax(a^2x^2+1)-2a^2Ax^3}{(a^2x^2+1)^2}$$

$$=\frac{2Aa^2x^3+2Ax-2a^2Ax^3}{(a^2x^2+1)^2}$$

$$=\frac{2Ax}{(a^2x^2+1)^2}$$

This equation may now be reduced to a function of s.

$$x=2s-s^2$$

$$\frac{dx}{ds}=2-2s$$

$$\frac{d\frac{U}{V}}{ds}=\frac{2Ax(2-2s)}{(a^2x^2+1)^2}$$

To fulfil the condition $\frac{dP_c}{ds}=0$,

$$-P_{co}(2s-2)=\frac{2Ax(2-2s)}{(a^2x^2+1)^2}$$

Substituting $A=P_{ck}(a^2+1)$ and simplifying the equation,

$$\frac{P_{co}}{P_{ck}}=\frac{2(a^2+1)x}{(a^2x^2+1)^2}=\frac{2(2s-s^2)(a^2+1)}{[(2s-s^2)a^2+1]^2}$$

A graphical method for solving this equation may be used by plotting the relation of P_{co} to P_{ck} as a function of s. There would, however, be a separate curve for each value of a; two of these are given in Fig. 8, where curve a_0 shows the relation for the case of zero leakage reactance, and curve a_1 for the case where leakage reactance equals resistance.

For $a=0$ the equation becomes

$$\frac{P_{co}}{P_{ck}}=2s(2-s)$$

For the very small fractional values of s the value of s^2 can be neglected as compared with s, and the equation is,

$$\frac{P_{co}}{P_{ck}}=4s(a^2+1)$$

$$=4s \text{ (when } a=0)$$

$$=8s \text{ (when } a=1)$$

These curves, or the equations just given, enable one to find, for any known relation of $\frac{P_{co}}{P_{ck}}$, the slip at which the rotor losses are at a minimum. It is evident that for any well-designed motor the value of P_{co} is always very much smaller than P_{ck}, and that the minimum rotor copper losses occur at a speed very close to synchronism.

Assuming, for instance, that the value of P_{co} is 10 per cent of P_{ck}, it is found from the curves that the minimum copper losses occur at a slip of 2.5 per cent when $a=0$, or at a slip of 1.5 per cent when $a=1$.

From the above treatment it is to be noted that a single-phase induction motor having a wound rotor with commutator and four brushes for each pair of poles has from 20 per cent to 34 per cent more losses, not including brush losses, than has a corresponding squirrel-cage motor developing the same torque, assuming the resistance per bar to be the same in the two cases.

The total copper losses in the rotor can always be expressed as

$$P_c = P_{cb} + P_{ca},$$

where P_{cb} are the copper losses due to the rotor magnetizing current in axis b-b' and P_{ca} are the copper losses due to the working current in axis a-a'. This equation is true regard-

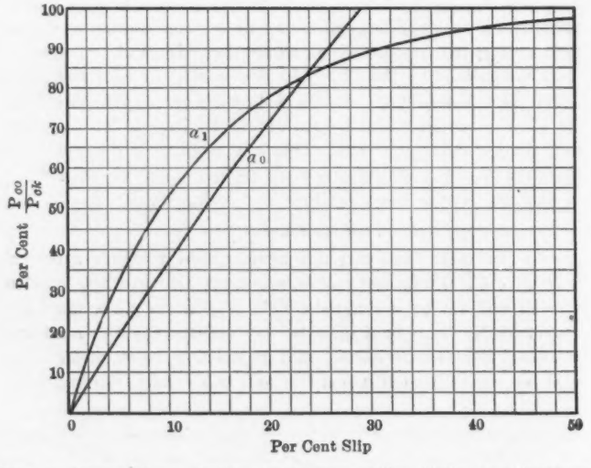


Fig. 8—Copper-Loss Ratios at Various Slips With and Without Leakage.

less of the winding distribution and time-phase displacement of the currents.

Neglecting the copper losses due to the rotor-magnetizing current, the rotor losses can be expressed as

$$P_{ca}=O\frac{2s}{1-s}$$

O = output of motor.

s = slip.

This equation holds true for squirrel-cage rotors even where the leakage reactance voltage is considered; however, it is assumed that the speed is close to synchronism.

The space-phase displacement between rotor current and e.m.f. of rotation can be measured by the relation

$$\tan\alpha = a = \frac{\omega LC}{R}$$

Since C is a function of slip, there may be written

$$\tan a=\frac{\omega L}{R}(2s-s^2)$$

$$=\tan a_0(2s-s^2)$$

The rotor losses are not a minimum at synchronism, but at a certain value of slip which is a function of $\frac{P_{co}}{P_{ck}}$, as given in Fig. 8, where P_{co} = rotor loss in axis b-b' at synchronism. P_{ck} = rotor loss in axis a-a' at standstill.

RECENT PROGRESS IN THE FIXATION OF ATMOSPHERIC NITROGEN.

By John B. C. Kershaw.

CONSIDERABLE progress was reported during the year 1910 in the industrial development of furnaces and processes for the fixation of atmospheric nitrogen. It is estimated that 100,000 hp is already applied to these processes of manufacture, and that by the end of 1911 this total will be more than doubled.

The methods in use may be divided into two broad classes. To the first belong the processes in which a direct union of the oxygen and nitrogen of the air is effected, the air being brought to a very high temperature by means of a large and extenuated form of electric arc. To the second class belong those processes in which the nitrogen of the air is caused to combine with calcium carbide to form calcium cyanamide. The present article is confined to the processes of the first-mentioned class in operation upon a commercial scale at the present date.

So far, the chief success with these processes has been secured in Norway, whose high-head water-power enables an electrical hp-year to be developed in many cases at the extremely low charge of about $5. There seems no proof as yet, however, that the fixation processes can be worked successfully in countries where the lowest charges for energy are double or treble this amount. Improvements in the design and yield of the furnaces for the arc processes are, however, widening the area within which they can be successfully operated, and it is by no means beyond the bounds of probability that in the course of the next few years we may witness successful installations of this character in the United Kingdom and in America. Several plants for the production of calcium cyanamide have already been started in North America.

The Birkeland and Eyde process is one of the oldest successful direct-combination processes, having been operated at Notodden, in Norway, since 1905. The latest developments in connection with the enlarged works erected by the Aktieselskabet Notodden Saltpeterfabrik, at Notodden, in 1907, have been described by the two inventors, Mr. Eyde and Professor Birkeland, in papers read before the Society of Arts and the International Chemical Congress in London, May, 1909. The works at Notodden now contain thirty-six 1500-hp furnaces, replacing the three original 800-hp units. Eight of these large new furnaces are run in series. The air is blown into the electric arc or flame disk, which is 10 ft. in diameter and about 4.5 in. in thickness, through ducts and openings arranged radially in the walls of the furnace.

The Svaelgfos power station, from which the Notodden works derive their energy, is about three miles distant on the Tinn River. A dam has been constructed which raises the level of Lakes Tinnsjoen and Mosvand by 56 ft., and by means of a tunnel and four almost vertical channels cut through the solid rock an effective head of 140 ft. is obtained at the power house. The turbines are four in number and are each of 10,000 hp to 11,000 hp capacity. They run at 250 r.p.m. and produce normally 40,000 hp to 45,000 hp. They were constructed by the firm of Voith in Heidenheim, Germany. The generators were built by the Allmänna Svenska Elektriska Aktiebolag at Vesteras, Sweden, and are three-phase machines, delivering in each phase 600 amp at 10,000 volts.

As regards the financial results the output of nitrates at these works in 1908 was valued at $555,000, and the total expenses amounted to $415,000, leaving a net profit of $140,000. The average power used during 1908 was only 13,000 kw. For 1909 the British consul at Christiania reports that the new industry has been working under fairly favorable conditions, but that lack of water-power has prevented the factory attaining the output of 20,000 tons expected when the plant was completed. The actual production figures in 1909 have been: Nitrate of potassium, 12,600 tons; nitrates of soda, 2,700 tons; nitrate and nitrite of soda, 370 tons; total, 15,670 tons. Owing to the low prices which ruled during the year the profits were less than in 1908. A plant for the manufacture of nitrate of ammonia was erected at Notodden in 1909.

Professor Birkeland in December, 1908, patented a new form of furnace in which an elongated form of revolving arc takes the place of the disk arc of the earlier type of furnace. The electrodes are placed at a considerable distance apart, and a magnetic field is set up within the furnace by an external coil. The arc is started by moving one electrode near to the other. When separated the flame rotates within the chamber of the furnace, and the air, which is blown in through openings at one end, is carried round with the arc flame and brought into intimate contact with it before escaping from the other end of the furnace. In this way ample opportunity is obtained for heating the air and for thorough mixing of the products of combustion with the excess air.

Experimental trials with this new type of furnace are at present being carried out in Norway, and it is possible that it may ultimately replace the earlier type now installed at Notodden. So far the factory at Notodden is the only one operating the Birkeland and Eyde furnace.

The Badischen Anilin und Soda Fabrik type of furnace was patented in 1905 and consists of a double-walled iron tube along the axis of which a column of arc flame is made to burn steadily and quietly by ingenious yet comparatively simple means. The air is blown into the tube with a tangential direction and comes into intimate contact with the arc, causing it to elongate in an upward direction. By use of circulating water

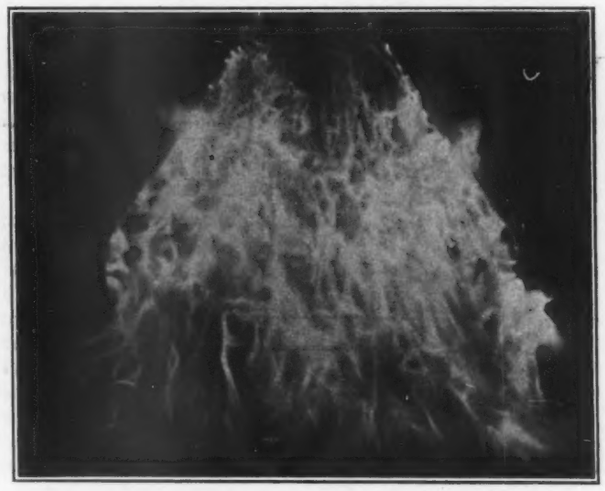


Fig. 1—Pauling Form of Arc Discharge for Nitrogen Fixation.

the gases are quickly cooled and decomposition of the already formed nitrous gases is prevented. The exit gases leaving the tube contain, it is stated, 2 per cent of nitric oxide, or about one and a half times as much as that obtained in the earlier Birkeland and Eyde type of furnace.

An experimental factory for trial of this furnace was erected by the Badischen company at Fiskaa, near Christiansand, in Norway in 1907, and the trials have led to valuable results. Three-phase, 4200-volt energy is employed, the 600-hp furnaces being connected in star and each containing a flame arc of 16.5 ft. in length.

The temperature of the flame is believed to be about 3000 deg. C. along its entire length, and the incoming air attains this temperature gradually during its passage up the tube. At Christiansand the air is preheated to 500 deg. C. before entering the furnace and leaves it through a water-cooled header at 1200 deg. and containing 2½ per cent of NO. These exit gases give up another 350 deg. of their temperature in heating the incoming air, and then pass through a steam boiler which utilizes 30 per cent of the total heat available, generating steam for the engine-driven apparatus used to concentrate the gases later. The gases from the furnace, now at 200 deg. C. to 300 deg. C., are then absorbed in caustic alkali liquor and

worked up for calcium nitrite according to the method described in German patent No. 188,133, granted to the Badischen Anilin und Soda Fabrik.

In the 1000-hp furnace using a higher voltage the arc length is increased to about 23 ft., and about 40,000 cu. ft. of air is required per hour. Still larger furnaces, up to 2000 hp, are now

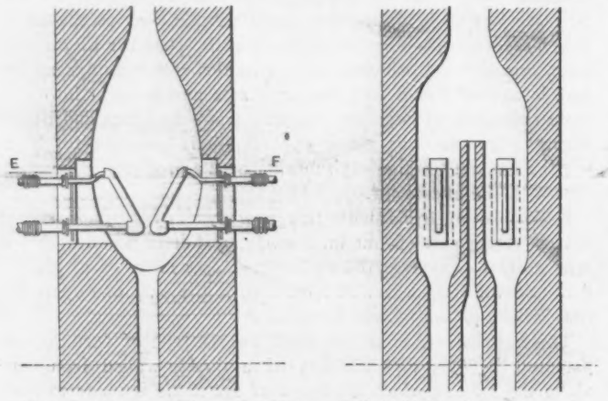


Fig. 2—Sections Through 400-kw, 4000-Volt Pauling Furnace.

being tried at Notodden to determine the size best suited for the large works to be equipped in the interior of Telemarken, on the Rjukan. The energy actually used in the formation of the nitric oxide, according to Schönherr, amounts to only 3 per cent of the total required by these processes, but a large amount of the heat energy of the arc is recovered in other ways. An investigation of the Badischen furnace at work has shown that 40 per cent of the heat of the arc is obtained in hot water, 30 per cent is recovered in the steam boiler, and that another 10 per cent can be recovered from the gases by water-cooling after they have passed through the boiler. The actual loss of heat is, therefore, 17 per cent, and is put down to radiation.

The Badischen Anilin und Soda Fabrik type of furnace is to be employed at the nitrate factory now being erected for utilizing the immense water-power development on the Rjukan, in Norway, and will also be used at a factory at Burghausen, in south Bavaria, and at some yet undetermined locality in northern Italy. Of these schemes the first named is most advanced, and two new Norwegian companies with a combined capital of 34,000,000 kroner ($9,460,000) have been floated to finance the developments, the Badischen company having combined with the Notodden company in promoting these new undertakings. There are two developments of the Rjukan water-power, the upper fall, which is expected to produce 140,000 hp, being the first dealt with. Ten 14,000-hp water-turbines driving 11,000-volt, 50-cycle, three-phase alternators at 250 r.p.m. are to be installed. According to Director Bernthsen the power station and factory will be ready for operation in 1911. The nitrate produced will be carried by twenty-nine miles of new narrow-gage railroad to Lake Tinn, and from there steam ferries will transport it twenty-five miles to Notodden. The lower fall of the Rjukan, capable of producing 110,000 hp, and other water-powers on the Matre and the Tyn, in west Norway, have also been acquired by the Norsk Kraft-Aktieselskabet and will be held in reserve for future use. In a comparatively few years, therefore, the Badischen furnace and process may be producing 100,000 tons of nitrate per year from the nitrogen of the air. Although no figures for the cost of operating the Badischen process have yet been made public, one may assume that it will yield rather more favorable results than other processes, since the furnaces are of simpler construction and the yield of nitric oxide is higher.

A third system of nitric-acid and nitrate production which has attained trial upon an industrial scale is that invented by the brothers H. and G. Pauling and now being employed by the Saltpetersaüre Industrie Gesellschaft, at Patsch, near Innsbruck, in Austria, and by a French company at La Roche de Rame in the High Alps, Savoy. An Italian plant is also in course of erection.

The process employs flaming arcs formed between two hollow iron conductors similar in shape and design to the well-known horn lightning arresters, giving the discharge form shown in Fig. 1. The arc is started at the narrowest point of the open V by secondary conductors, is carried upward by the current of air blown in from below and breaks at every half period of the alternating-current cycle only to be renewed again at the lowest point. The main electrodes are of iron, are water-cooled and produce an arc 1 m in length at the widest point. They last about 200 working hours. An opening about 1.5 in. in width is left at the narrowest gap, the arc-starting electrodes projecting into this space within a fraction of an inch of each other. These secondary conductors are designed to offer minimum resistance to the air current, but require frequent readjustment as their ends are quickly burned away. The gases are cooled after passing through the flame chamber by air blown into the upper part of the furnace chamber. A concentration of 1.5 per cent of nitric oxide is said to be obtained with this type of furnace. The furnaces, shown in Fig. 2, are built of brick, each inclosing two flame-arcs, which consume 400 kw at 4000 volts. Each furnace requires 600 cu. m of air per hour, not including the cooling-air supply. At the present time twenty-four furnaces are installed at the Patsch works (Fig. 3), the control of these being so simple that one man can superintend the work of six furnaces. The yield of nitric acid is 60 grams per kw-hour.

The present capacity of the Patsch works with all the furnaces in operation is, therefore, 576 kg per hour, or 4608 tons of nitric acid per year. The hot gases leave the furnaces at a temperature of 700 deg. C. to 800 deg. C., their heat being utilized for heating the incoming air and for concentrating the acid or solutions of nitrate. The Innsbruck factory, shown in Figs. 4 and 5, now utilizes 15,000 hp. Its success has been sufficient to warrant the erection of works for operating the same process and furnace in the south of France and in the north of Italy. These new works are each of 8000 hp capacity. The former has been built and is operated by La Nitrogène Société Anonyme, at La Roche de Rame in the High Alps. Power is obtained from a fall on the Biaysse, a tributary of the River Durance, four sets of turbo-generators, each of 2000 hp, being installed. The nitrous gases, at a temperature of 700 deg. C., pass through apparatus in which a portion of their heat is given to the incoming air, and then through two brick cooling towers. These gases are then forced by fan

Fig. 3—Interior of Patsch Plant, Showing Arc Furnaces.

action through the oxidizing chamber, or tower, 70 ft. high and 33 ft. in diameter, and finally through five absorbing towers, in which the nitric acid is produced. A sixth tower is employed for concentrating the acid furnished by the other five and all strengths of nitric acid testing from specific gravities of 1.332 to 1.515 are produced. The acid is exceptionally pure, being

quite free from sulphates or chlorides, and meets with a ready sale. The nitrous gases which have escaped oxidation are used for the production of sodium nitrite.

The yield of the Pauling furnaces is from 60 grams to 70 grams of nitric acid per kw-hour.

The Moscicki furnace and process are the invention of Messrs. Kowalski and Moscicki and are being operated by the Société de l'Acide Nitrique at Fribourg in Saxony. Few details of this installation have yet appeared in print, but as two separate companies have been formed to exploit the process it must be assumed that the experimental plant at Fribourg has achieved some success. The early type of furnace used by these inventors was planned on the Bradley and Lovejoy model. It involved a large number of arcs and the use of alternating currents of relatively high potential—25,000 volts to 50,000 volts. In their earlier experiments at Vevey, Switzerland, the inventors obtained a maximum output of 440 kg nitric acid per kw-year when using a current of 0.05 amp, and a frequency of discharge of 6000 cycles to 10,000 cycles per second, at a pressure of 50,000 volts. This method failed on account of the high cost of installation. Increase of the electric energy in each flame was followed by a decrease in the efficiency of the process, and the resulting large number of flames necessitated complicated and expensive apparatus for control purposes. In the new form of apparatus devised by Moscicki the principle of magnetic deflection of an arc flame is employed. Two concentric ring-electrodes of copper are used and the arc passes from the inner to the outer ring in a radial direction. A magnetic flux draws the hottest portion of each arc flame down into the annular space between the two rings and the revolving arc takes on the appearance of a luminous ring of flame which fills the space between the two electrodes. The air or gases are forced through the revolving arc flame under pressure and are quickly cooled by contact with the outer metallic electrode through openings into which they escape. Assuming that all the conditions and dimensions of the early experimental trials have been found suitable for the 500-kw furnaces now being operated, only 17.5 cu. ft. of air or gas will be required for each kw-hour of flame-energy, as compared with 87.5 cu. ft. in the ordinary types of flame-arc furnace. A minimum yield of 60 grams of nitric acid per kw-hour can be obtained with the furnace and the most recent results have proved that this yield can be increased.

Haber and Koenig, in a recently published article, give the

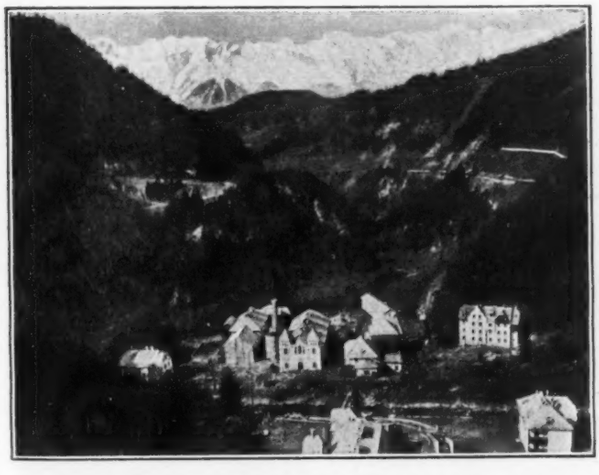


Fig. 4—Nitrate Factory at Patsch, Austria.

figures printed in the next column for the yields and concentrations obtained with the three leading processes of nitric-acid production from the air.

It has been calculated by Haber from thermo-chemical data that theoretically one kw ear should produce 1000 kg of nitric acid. Without making any allowance for the heat recovered it may be estimated from this figure that the thermal efficiency of the Schönherr furnace is about 63 per cent.

As regards modifications of the existing furnaces and methods of working a very large number of patents have been granted during the past three years. Many chemists are directing their investigations toward the improvement of the yield

Fig. 5—Water-Power Plant and Nitrate Factory at Patsch, Austria.

obtained from the Birkeland and Eyde and Badischen type of furnace; and it is probable that in the near future gas mixtures containing not 2 per cent of nitric oxide, but treble and quadruple this amount, will be obtained with little or no alteration in the furnace design. Thus Haber and Koenig have proved that by using a gas mixture containing 50 per cent of oxygen the concentration of nitric oxide can be increased to 14.4 per cent. The use of Nernst filaments as electrodes also increases the yield of nitric oxide. In the opinion of these investigators the reaction between the oxygen and nitrogen of the air is not purely thermal in character, and by use of an

	Grams Nitric Acid per Kw-Hour.	Concentration Per Cent of NO.
Pauling Process	60	1 to 1.5
Birkeland and Eyde	70	2
Schönherr	75	2.5

"ionizing" arc flame like that produced with Nernst electrodes the oxidation of the nitrogen occurs at a much lower temperature than has hitherto been supposed.

Sir William Ramsay has also turned his attention to the subject and has suggested separating the atmosphere into its two constituents, oxygen and nitrogen, by the fractional distillation of liquid air. The oxygen would then be employed in the electric arc method of nitric acid manufacture, and the nitrogen for the production of calcium cyanamide by the Frank and Caro process. This plan for its successful operation would therefore involve the erection and working of the two rival

nitrogen-fixing processes side by side. Du Pont, of the Nemours Powder Company, has patented a process which has points of resemblance to both the Birkeland and Eyde and Badischen processes. A long tube of quartz glass is used, with electrodes at each end. The arc which forms between these electrodes is deflected and kept in rotation by means of a series of rotating magnetic fields, each successive field along the length of the tube being of reversed polarity to those on either side of it. In this way the arc is caused to rotate and to move from side to side of the tube, and the air in its passage through the tube has to pass through the arc as many times as the arc is deflected.

Haber and Koenig have patented the use of reduced pressure and intentional cooling of the arc flame. Reduced pressure alone produces no change in the yield, but when allied with a reduction in the temperature of the arc it is easy to produce gases containing 9.5 per cent to 10 per cent nitric oxide when using air, and 13½ per cent to 14 per cent when using a 50 per cent mixture of oxygen and nitrogen gas.

The pressure is maintained at not more than one-half atmosphere, and electrodes of metal or of calcium and magnesum oxide are employed. The cooling is effected automatically, since the arc, which at ordinary pressure assumes the form of a thin rod, under reduced pressure expands and touches the walls of the tube which, being cooled artificially, remove the heat from its flame. In this way discharge flames are produced which do not inclose the zone in which nitric oxide gas is decomposed again into nitrogen and oxygen. The patent, No. 938,316, for this modified process has been assigned to the Badischen company.

Whether it will prove economical to adopt any or all of these patented modifications of the methods of working the furnaces and processes now in practical operation will doubtless be decided by practical trials in the course of the next two years.

Central Station
Management, Policies and Commercial Methods

MUNICIPAL-OWNERSHIP DEFEAT AT LINCOLN, ILL.

Lincoln, Ill., a city of 10,000 inhabitants, has had during the past five years a contract for street lighting with the Lincoln Water & Light Company at a very low rate. In January bids were advertised for street lighting for five years after March 1, 1911. The Water & Light Company presented the only bid, which was a considerable advance over the existing price. The bid was rejected and the lighting committee of the Council secured figures on a municipal lighting plant.

On Feb. 25 the company started a publicity campaign, giving facts on municipal ownership, showing what the general experience had been with municipal ownership in the past and estimating the lowest possible cost of operating a municipal plant such as was proposed by the lighting committee. The reasons for increasing the price of street lamps were also given.

On March 1 the contract expired, but the company continued the street lighting without a contract for two weeks, when a temporary contract was made, extending to May 1, the last date on which the company could use the present lamps, owing to the replacement of the 133-cycle equipment with 60-cycle equipment.

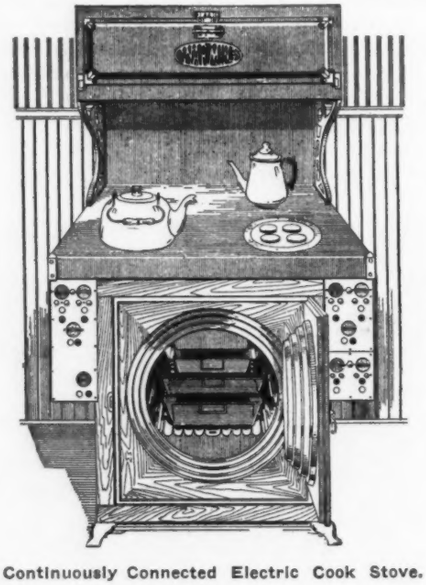
It was brought to the attention of the business men, through the company's advertisements, that the city must necessarily be dark after May 1 unless a contract was immediately made, and on March 27 the Council met for the purpose of passing an ordinance submitting municipal ownership to a popular vote. On the same evening the directors of the newly organized Commercial Club met and appointed a committee to visit the Council chamber immediately and ask that Council postpone action until the lighting committee could confer with the directors of the Commercial Club. The Council meeting was adjourned until the following evening, and the lighting committee was asked to name an hour at which it would meet the Commercial Club directors.

The next afternoon the lighting committee and the Commercial Club directors held an executive session lasting several hours, during which the information published in the company's advertisement was gone over and fully discussed. When the Council reconvened in the evening the municipal-ownership ordinance was unanimously laid on the table and the Council unanimously approved a proposal from the lighting company for a new contract. The contract gives the company a net return of about $600 per year more than the former contract and precludes any further consideration of municipal ownership for at least five years.

The publicity campaign was undertaken by the Public Service Publishing Company of Chicago, under the personal direction of Mr. Glenn Marston.

CONTINUOUSLY CONNECTED ELECTRICAL COOK STOVES IN CLEVELAND.

Among the residence consumers of the Cleveland Electric Illuminating Company there are now in use about fifteen of



Continuously Connected Electric Cook Stove.

the continuously connected electric ranges, the idea of which is due to Mr. M. E. Turner, contract agent of the company. This stove, employing the fireless-cooker principle and having its interior held at a cooking temperature of 400 deg. Fahr. by the continuous night and day operation of a 150-watt heating element, was designed to avoid the short-hour heavy demands of equivalent electric cooking aparatus. Its thermal insulation and heat-storage capacity enable the energy delivered to it continuously throughout the twenty-four hours to be held and conserved for cooking purposes at any time. The 400-deg temperature continuously maintained serves for baking, roasting, boiling or any kind of cooking except frying. For broil-

ing, in addition to the 150-watt continuous heater in the oven, there is an 1800-watt incandescent-type broiler element mounted directly over the shelves. In the intense radiation of this broiler and at the oven temperature meat is quickly done to a turn. The broiler cannot be left on, however, with the oven closed, which might endanger overheating, since the oven door is fitted with an arm which presses the "off" push-button of the broiler switch when the door is closed. The oven is cylindrically shaped to present the least heat-conducting surface, and is thoroughly insulated against radiation and conduction. It is spacious enough to hold the largest turkey.

On the shelf or top of the oven are four electric hot plates, two taking 100 watts at low heat and 400 watts at high heat and two others each taking four times as much power. These hot plates are useful for all cooking operations, including frying. Food that has been cooked is kept warm in a special warming box above the oven, also electrically heated. All of these special heaters, including the hot plates, broilers, warmer and the continuous heater, are controlled by push-button switches mounted at the side of the range. Each circuit is also equipped with different-colored indicating lamps behind a glass lens of the switchboard type, showing at a glance what heaters are in use and whether they are operating at high or low heat.

While the present type of range has its continuous heater fitted with a switch, the newer forms will have the oven element connected directly to the lines so that it cannot be turned off except by opening the main house switch. With the oven thus maintained always at cooking temperature the customer will be encouraged to cook with the heat available rather than to turn on for a short time one of the hot plates having a large demand. All cooking appliances on the Cleveland company's lines come under its secondary charge of 5 cents per kw-hour, their demand not being figured into the bill. After practical experience customers have expressed themselves as well pleased with these electric stoves. The heat is of a peculiarly uniform quality, and is supplied to the cooking food from all sides as well as the bottom once the oven is heated. The monthly bills of consumers where these stoves are in use have ranged from $6 and $8 to $15. Of this $5.40 is probably due to the 108 kw-hours consumed by 720 hours' or 30 days' continuous operation of the 150-watt heater at the 5-cent rate.

SHOWCASE, WINDOW, OUTLINE AND SIGN LIGHTING.

At the convention of the Minnesota Electrical Association held in St. Paul, March 14, a paper on the subjects of "Showcase Lighting, Display-Window Lighting, Outline Lighting and Sign Lighting" was presented by Mr. T. R. Wilwerschied, of St. Paul. The speaker deplored the lack of assistance thus far given merchants in lighting their showcases and declared that this field represents a large income for the central-station company. Department stores and those larger merchants who could afford to experiment until they found satisfactory showcase lighting attest the advertising value of these displays, but the electric company's expert should be equipped to see that the little customer can profit in the same manner, while in the meantime the company secures connected service of good load-factor. Outline lighting, said Mr. Wilwerschied, is another department in which the new-business solicitor fails to realize his opportunities. Outline lighting is a powerful advertising force now monopolized by big businesses. Meanwhile the smaller merchant, convinced of the high cost of such an installation, takes no trouble to investigate. The lighting solicitor should demonstrate to these possible users that the expense is not excessive, but entirely within their reach. Mr. Wilwerschied, after long experience in the manufacture of electric signs, declares that for practical reasons central-station companies should supervise the signs erected on their lines. This arrangement, he thinks, enables the customer to obtain through the company and at the lowest price the best grade of sign construction, insuring lasting satisfaction. Safe and proper mechanical and electrical construction is also assured. The interest of the local electrical solicitor also serves to close many negotiations that would otherwise drag along and might eventually be given up. In the case of some progressive companies, declared the speaker, the gross income for "advertising lighting," exclusive of all other street lighting, reaches $1 and more per capita.

Mr. H. J. Gille, of Minneapolis, in discussing Mr. Wilwerschied's paper, pointed out that until recently showcase lighting has been impossible on account of the construction used by the cabinet builders. The tungsten lamp has greatly changed conditions in outline lighting as in electric signs, effecting the rapid development of the latter more than any other agency. A display once costing $100 a month to operate with carbon-filament lamps now costs $25 per month with tungsten lamps. Mr. Gille also spoke of the changes in sign construction and the favor with which municipal authorities now regard electric signs, as sources of both beauty and illumination. Mr. Wilwerschied recounted his own successful experience with 2.5-watt tungsten sign lamps, no renewals being needed in three months' operation after the first weaklings were eliminated, although the loss during these first weeks reached almost 40 per cent. Mr. F. J. Benson said the cost of the 2.5-watt sign lamps is the same as the 5-watt lamps, but the introduction of the smaller units is yet under consideration from a policy viewpoint on account of their reduced energy consumption. Mr. Findlay suggested that, without reducing the wattage of a given display, the smaller lamps might be placed closer together, improving the effect of continuity of designs. Mr. R. W. Clark advocated a change of sign-lamp size in the direction of 10 watts, if at all, rather than 2.5 watts, since he considers that the smaller lamps may give too dim a display and so would not be conducive to the perpetuation of the business. Mr. J. B. Crane spoke of the way in which ornamental post lighting may detract from signs and vice versa. Mr. H. Schroeder, of Harrison, N. J., told of the large range of sizes, from 2.5 watts to 25 watts, in which low-volt lamps are now manufactured, and spoke of the use of candelabra-base sign lamps in indoor show-window displays. Mr. H. E. Griffin suggested a little missionary work on the part of electrical men in mentioning the use of electric signs and devices to merchants and others, wherever these could be used to advantage. Such propaganda benefits the industry, and Mr. Griffin told of some direct results gained from one instance of this kind.

CENTRAL STATION FACTS AND FACTORS FROM IOWA.

Mr. Austin Burt, of Waterloo, Iowa, who is the facts and factors committee of the Iowa Electrical Association, made to the convention of that body at Davenport on April 11, 1911, the most complete report on Iowa central stations yet compiled. His first report, made in 1909, tabulated facts and factors from twenty-six companies. This table appeared in the first issue of the *Electrical World* for May, 1909. The form of the report is, in the main, the same as that used by the *Electrical World* in tables appearing in the issues for April 29, 1909, June 24, 1909, and Jan. 13, 1910.

Mr. Burt's 1911 report contains results from thirty-one companies. The table is given in full herewith. Inquiries were sent to 148 companies and thirty-one available replies were received. The returns were unsigned.

In estimating net earnings on investment 2 per cent depreciation was allowed on the investment. Some of the factors Mr. Burt considers erratic, but he thinks the averages good.

For comparison with the 1909 report the averages for each group are given for both 1909 and 1911.

stead of the total hours per year. It seemed to be agreed that from a financial point of view the total hours per year should

STATION NUMBER	Population of District	Number Consumers per 100 Population.	Station Rating.	Station Rating per Capita.	Station Rating per Employee.	Ratio Station Rating to Connected Load.	Average Load During Operation.	Ratio of Average Load to Station Rating.	Annual Load Factor.	Investment per Kilowatt of Rating.	Investment per Capita.	Gross Income per Kilowatt of Rating.	Gross Income per Consumer.	Gross Income per Capita.	Gross Income per $100 Invested.	Gross Income per Kw-hour Made.	Ratio Expense to Gross Income.*	Net Earnings per $100 Invested.†	Total Hours of Operation per Year.
	Number.	Number.	Kilowatts	Watts	Kilowatts	Per Cent.	Kilowatts	Per Cent.	Per Cent.	Dollars.	Dollars.	Dollars.	Dollars.	Dollars.	Dollars.	Cents	Per Cent.	Dollars.	Hours
1.....	700	13.4	70	100	70	200.0	10.0	14.3	30.0	100	10.00	50.00	37.20	5.00	50.00	15.9	40.0	....	2,196
2.....	750	13.3	75	100	37	115.0	45.0	60.0	80.0	66	6.66	40.00	30.00	4.00	60.00	21.1	50.0	....	3,110
3.....	800	11.3	40	50	40	....	....	....	....	187	9.40	45.10	20.10	2.26	24.10	....	62.8	6.60	2,160
4.....	1,200	11.1	100	83	33	....	11.9	11.9	7.5	259	21.60	74.00	55.70	6.16	28.60	10.2	70.0	5.72	6,050
5.....	1,300	14 9	65	50	22	....	8.8	13.5	11.6	338	16.90	176.00	93.30	5.38	31.80	10.0	77.6	3.64	8,000
6.....	1,300	20.2	50	38	25	33.0	9.8	19.6	24.3	270	14.20	133.00	25.30	5.13	36.10	17.2	83.9	2.34	3,987
7.....	1,500	10.0	100	67	50	100.0	....	....	30.0	136	9.60	68.00	45.30	4.53	49.90	....	99.0	−5.10	6,500
8.....	1,500	10.0	60	40	12	31.0	11.4	19.0	19.0	367	14.60	125.00	50.00	5.00	34.10	7.5	66.7	7.96	8,760
9.....	1,600	4.1	100	62	33	83.0	....	....	....	90	5.60	72.00	107.50	4.50	81.00	....	77.5	10.00	2,600
10.....	1,750	16.1	150	86	75	100.0	15.8	10.5	19.8	100	8.60	51.50	27.60	4.42	51.60	8.2	85.7	2.23	6,000
11.....	2,000	7.2	120	60	30	....	27.9	28.2	56.0	200	12.00	60.80	50.70	3.65	30.40	3.3	91.2	−.38	7,800
12.....	2,000	6.0	75	37	25	112.0	23.9	31.9	....	180	6.75	72.00	45.00	2.70	40.00	8.8	86.2	1.48	2,555
13.....	2,000	9.1	55	27	18	67.0	29.9	54.0	60.0	273	7.50	129.00	39.00	3.57	47.50	7.4	64.7	12.10	3,240
Average, 13	1,415	11.9	82	62	36	93.4	19 4	26.3	33.8	205	11.03	84.30	48.20	4.33	43.50	10.9	73.4	4.23	4,840
Average, 10–1909.	1,600	10.0	67	42	27	93.5	....	....	36.0	236	10.00	94.00	37.00	4.06	38.00	....	70.0	....	....
14.....	2,500	13.0	100	40	20	50.0	30.0	30.0	43.7	250	10.00	131.50	40.40	5.26	52.60	7.1	80.7	.91	6,120
15.....	2,500	18.0	155	62	26	32.0	37.9	24.4	31.6	229	14.20	98.20	30.50	5.48	38.60	4.16	66.2	8.82	8,700
16.....	2,600	8.8	250	96	50	83.0	27.4	10.9	23.7	120	11.55	55.60	60.40	5.35	46.40	5.82	77.3	5.87	8,730
17.....	3,000	10.8	125	42	21	....	....	....	....	160	6.67	48.00	18.40	2.00	30.00	....	80.0	10 00.	6,500
Average, 4.	2,650	12.7	157	60	29	55.0	28.4	25.1	33.0	190	10.61	83.20	37.40	4.52	41.90	5.70	76.1	6.39	7,620
Average, 8–1909..	2,470	10.0	122	44	38	47.6	....	....	....	221	9.40	95.00	43.00	4.04	41.00	....	63.0	..	....
18.....	3,200	11.7	125	39	25	103.0	20.1	16.1	22.0	256	10.00	88.60	29.60	3.46	34.60	6.66	77.9	4.16	8,270
19.....	4,000	11.9	250	63	15	43.4	58.0	23.2	22.0	294	18.40	125.30	65.90	7.83	42.50	6.16	61.4	12.18	8,760
20.....	4,000	15.3	370	93	53	86.0	35.4	9.6	36.2	157	14.52	54.00	32.60	5.00	35.00	11.00	57.5	11.18	5,143
21.....	4,500	11.5	180	40	26	90.0	25.0	13.9	35.0	352	14.43	90.40	31.30	3.62	25.10	7.43	85.5	1.12	8,760
22.....	5,000	7.2	210	42	26	62.0	51.0	24.3	19.0	241	10.13	61.80	36.40	2.59	25.60	3.50	58.3	8.14	7,250
23.....	7,800	11.5	300	39	50	59.0	63.0	21.0	26.0	187	6.40	111 00	37.00	4.27	66.50	6.03	55.5	23.00	8,760
Average, 6.	4,580	11.5	239	53	33	73.8	42.1	18.0	26.7	248	12.30	88.50	38.75	4.46	38.25	6.78	67.1	9.95	7,720
Average, 3–1909..	5,670	10.0	285	51	37	50.0	....	....	....	202	10.00	85.00	42.00	4.40	49.00	....	56.0	...	....
24.....	10,000	10.8	833	83	114	87.0	120 0	14.3	21.6	264	22.00	73.20	50.70	6.10	27.80	5.81	51.2	10.72	8,760
25.....	10,500	.....	2,000	190	200	....	....	....	....	....	....	....	....	....	....	....	....	....	....
26.....	14,000	10.1	850	61	77	43.0	77.0	9.1	23.5	300	18.20	60.00	36.30	3.65	20.00	7.57	59.6	6.04	8,760
27.....	18,000	4.3	1,350	75	193	111.0	146.0	10 8	19.3	296	22.20	39.70	73.20	2.97	13.40	4.22	59.0	4.13	8,760
28.....	20,000	8.4	1,000	50	56	39.0	222.0	22.3	26.0	250	12.50	87.40	51.70	4.37	34.90	4.48	50.0	13.96	8,760
Average, 4.	14,500	8.4	1,206	92	128	70.0	141 0	14.1	22.6	277	18.70	65.70	52.95	4.27	24.10	5.52	54.7	8.71	8,760
Average, 2–1909.	15,500	5.0	775	50	71	67.0	....	....	22.0	139	8.00	60.00	60.00	3.20	54 00	....	71.0	....	....
29.....	33,000	9.53	2,200	66	91	31.0	519.0	23.6	28.1	432	28.80	82.90	57.80	5.52	19.20	4.02	50.2	7.67	8,742
30.....	48,000	3.19	1,275	27	106	50.0	283.	22.2	37.0	580	15.40	77.40	64.30	2.06	13.30	3.98	43.8	6.17	8,760
31.....	86,000	5.80	5,200	61	45	46.0	1158.0	22.3	29.4	612	37.10	81.40	84.70	4.92	13.35	4.17	52.9	4.95	8,760
Average, 3.	55,600	6.17	2,890	51	81	43.0	653.0	22 7	31.5	541	27.20	80.50	68.90	4.17	15.27	4.06	48.9	6.26	8,750
Average, 3–1909..	53,000	5.00	2,110	46	262	42.0	....	....	24.0	195	9 00	88.00	79.00	3.50	42.00	....	51.0	....	....
Gr'd Av'ge, 31.....	14,920	10.62	576	64	51	72.0	117.0	22.0	30.1	252	13.85	82.10	47.60	4.36	36.80	7.75	67.5	6.63	6,710
Gr'd Av'ge, 26–1909.	9,411	9.00	401	44	63	56.0	....	....	32.0	220	9.60	89.50	46.00	3.93	41.60	....	64.0	....	....
Gr'd Av'ge, 1911 and 1909....	11,760	9.90	494	55	56	65.0	....	....	30.6	237	11.95	85.50	47.20	4.17	38.85	....	65.9	....	....

* Excepting depreciation. † With depreciation 2 per cent.

Stations are divided into five groups according to population, as indicated by the table, and the average for each group is given as are the grand averages for all.

The number of consumers per 100 population increased in each group over 1909. The station rating per capita also increased in a still greater proportion. The author expressed the belief that this fact is good evidence that the tungsten lamp has not cut the demand.

The connected load is much nearer the station rating in small plants than in the large ones. The smaller stations are enjoying higher gross revenues per kw-hour than the larger ones.

In the discussion of Mr. Burt's report some question was raised as to the method used for determining the average loads and load factors, using as a basis only the hours operated in-

be the basis, while from the operating engineer's standpoint the average load during the time of operation is of more interest. Both might well be given.

LIGHTING AND ELECTRICAL EQUIPMENT OF A CENTRAL-STATION OFFICE BUILDING.

By Ross B. Mateer.

To use electricity for lavish display lighting, charging the cost to advertising, is the prevailing idea among central stations. In many instances the customer is persuaded to advertise for his own benefit, the central station calmly watching the con-

sumer use the energy and forgetting that what is good for the consumer may prove advantageous to the company itself.

In planning the exterior of the new office building now occupied by the Denver Gas & Electric Company, Denver, Col., ample provisions were made for display lighting. The result is said to be the best lighted building in the world. The exterior presents a pleasing appearance during the day, while at night it is the brightest spot in the city, as the great number of people using Fifteenth Street, the main artery for traffic, will testify.

The exterior is of glazed white terra cotta and 9000 lamps of varying candle-power are used for night illumination. While the brilliancy characterizing the exterior is noteworthy, yet the interior is no less interesting. The main floor is scientifically lighted with tungsten lamps, the electric fixtures having satin-finished prismatic glass shades. The counters are of tile with vitrolite tops. All the woodwork used in office fixtures is African mahogany. The eye is attracted both by the brilliancy of the exterior and the beauty that characterizes the plain, yet striking, interior.

Some, not satisfied with mere display, exhibit the sagacity

Fig. 1—Denver Gas and Electric Company's Office Building by Night.

of the business man, whose forte is the mechanical end and the approximate cost. The questions asked lead to the disclosure of the most interesting and instructive part of the entire building. Elaborate exteriors are dwarfed before motor-operated pumps, the substation and the transformer rooms that occupy the basement.

What would the lamp-studded front of the building be without energy at night? Would one recommend steam-operated house pumps or deep well pumps in a building that represents the highest development in buildings of its class?

In the basement is installed an Ingersoll-Rand air compressor. It was designed for this building. The cylinders are 12-in. x 12-in. and 6½-in. x 10-in. The compressor is belted to a 60-hp Westinghouse motor and is used in connection with the artesian well 749 ft. in depth. The compressor, operating at a pressure of 135 lb., forces the water to the 10,000-gal. storage tank in the basement.

Two 3-in. single-stage centrifugal pumps, manufactured by the Buffalo Steam Pump Company, elevate the water 165 ft. to the huge storage tank located upon the roof. From this tank all the water used in the building is distributed by gravity pressure. Each pump is direct-connected to a 10-hp 500-volt "Northern" motor. The motor on the compressor and those on the house pumps are equipped with floats and an automatic starting device. Two sump pumps of 1½ hp each are installed in the boiler-room and one of the Union Steam Pump Company's vacuum pumps, operated by a 15-hp Crocker-

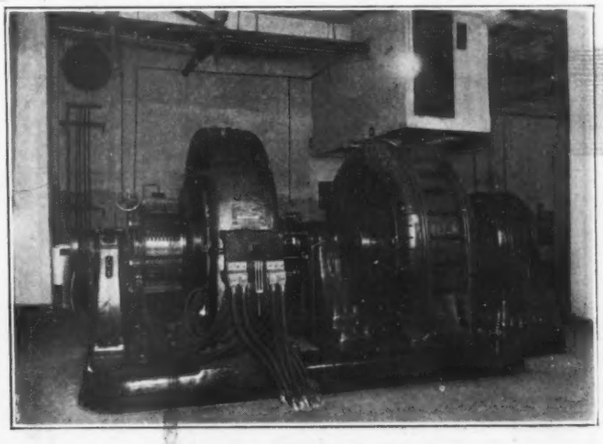


Fig. 2—Motor-Generator Set in Basement.

Wheeler motor, is installed in the basement. The elevators, manufactured by the Otis Elevator Company, are of the semi-traction type and are four in number. Each motor is designed for 470 volts and 51 amp, or 30 hp. A 5-hp General Electric motor is belted to a Connersville blower, which supplies the air for the pneumatic-tube system installed in the accounting department of the gas and electric company.

To provide for future needs and to be prepared at all times to supply energy to the direct-current motor network in the business section, as well as to provide for direct-current motor "peaks," a 750-kw motor-generator set has been installed in the basement. This consists of a 1150-hp, 2300-volt, three-phase, 60-cycle motor, direct-connected to a 500-550-volt direct-current generator. The speed of the motor-generator is 514 r.p.m.

The exterior lamp circuits are connected to a separate board of four panels installed in connection with the switchboard, controlling the interior lighting.

The remaining portions of the basement are used for trouble men, supply bureaus and a model demonstration room for gas and electric appliances.

Fig. 3—Motor-Operated Pumps.

The motor-operated pumps used in the building are an excellent example of industrial power drive that, if installed in other large buildings, will result in considerable revenue to the central station.

Wiring and Illumination

ORNAMENTAL CURB LIGHTING AT HAMILTON, ONTARIO.

Less than a year ago the Hamilton Electric Light & Power Company, Ltd., of Hamilton, Ontario, which is considered to be the most progressive of the Canadian central-station companies, not willing that the title of Electric City of Canada should be usurped by any other city in the Dominion through any lack of enterprise on its part, started among the merchants a campaign for ornamental downtown street lighting. The business center of the city, including about twelve blocks on either side of King Street and six blocks on either side of James Street, was chosen as the portion of the city to be thus illuminated. It was proposed by the company that it erect standards at its expense at each street corner, with other standards spaced about 45 ft. apart between corners, the equipment to be maintained in first-class condition and the lamps kept burning from dusk until 11 p. m. The merchants were asked to sign contracts agreeing to pay for the energy consumed in the lamps at the rate of 12½ cents per month for each front foot of property on the block. The rate was not contingent upon the location of the standards, each merchant paying the same regardless of whether a standard was in front of his store or not.

When the plans were formulated they were made known to the daily press, which published accounts of what was done elsewhere and what it was proposed to do in Hamilton. The merchants were then canvassed block by block and in less than a month four blocks were secured. To quicken matters two standards of the type chosen were erected on one block and a representative meeting of merchants was held to witness their lighting. A vigorous store-to-store campaign on a competing block was then inaugurated, the more progressive merchants on the first block being relied on to whip their neighbors into line on the proposition. So soon as the news was published that the "white way" had actually started and standards been ordered the merchants on the first block made contracts with the company for energy for the complete installation on that block. Soon afterward two other blocks were contracted for, followed by four additional blocks. Eight other blocks were subsequently added, so that the plan proposed at first was brought to fruition.

Fig. 1—Ornamental Street-Lighting Standards on King Street, Hamilton, Ontario.

The lamp-posts selected by the company are made of pressed steel and represent a tapered fluted column of classic lines. Each holds five tungsten lamps in diffusing globes. On the arms the lamps are of 100-watt size and in the central globe the tungsten lamp is rated at 125 watts. As the lighting circuits are overhead, the posts are fed from a transformer located on a pole in the middle of the block. Three wires in conduit are run down the pole from the transformer to the nearest standard, and from there energy is distributed to the other standards, the wires being in conduit run 3 in. below the pavement near the curb. The lamps on each block are controlled by a switch in the base of the standard nearest the transformer. Owing to the use of a three-wire system it is possible to burn the central lamp all night on a separate circuit should this be desirable or required later by the City Council.

Fig. 2—Standards and Sign at City Hall.

Fig. 3—James Street, Hamilton, by Night.

SCHOOL AND LIBRARY LIGHTING.

In a recent number of the *Electrical World* some account was given of progress in connection with illuminating engineering in Great Britain, especially as regards the discussions of the (British) Illuminating Engineering Society in London.

Since that date the society has held several successful meetings, which served admirably to show the kind of co-operation the society should help to bring about. In Great Britain it is recognized that there is still a great deal of spade work to be done in educating the general public to appreciate good lighting, and it is found there, as elsewhere, that long after the experts have come to an agreement regarding some point in illumination the general public continues to follow blindly the older and probably inferior methods.

It is, therefore, necessary to be bringing constantly home to the non-technical public the progress that has been made in expert ideas about lighting. There are, of course, many points on which it is impossible to dogmatize at present. But, on the other hand, there are some matters, some simple rules in illumination, on which agreement seems possible, and it is essential to spread a knowledge of these as far as possible. At the same time it is desirable to induce each section of the public to rate the question of good lighting as more important than it is now held to be; to persuade school authorities that the lighting of schools is one of the most important factors in their equipment, and to demonstrate to librarians and library committees what an important part the choice of correct lamps and fixtures and their correct location play in rendering a library successful and attractive.

The recent meetings of the (British) Illuminating Engineering Society, at which the two subjects of school and library lighting have been discussed, afforded an excellent example of the work such a society can do in this direction.

The first subject dealt with at meetings on Jan. 16 and Jan. 31 of this year was library lighting. On this occcasion the co-operation of the Library Association was sought, and a joint meeting of these two bodies was held. On the first night it was agreed that the librarian's standpoint should receive chief attention, and papers were presented by Mr. S. L. Jast, honorary secretary of the Library Association and librarian of the Croydon Public Libraries, and Mr. J. Duff Brown, public librarian at Islington. These papers led to a very interesting discussion, in which representatives of the British Museum Library, the Patent Office library, the Board of Education library and other well-known libraries in London took part. The discussion on this evening was not only a means of bringing home to engineers the chief matter on which librarians desire further information, but also suggested quite a number of points which are of considerable consequence to the librarian, but which the engineer, if left to himself, might easily overlook. It became evident that different classes of libraries have quite distinct demands as regards illumination, and that there are frequently points in local routine which have to be taken into account by the engineer when the lighting is being planned. Among the libraries represented some, like the British Museum, are purely for student and research work; others, like the Royal Colonial Institute, are more in the nature of reading-rooms, while public libraries again have their special departments devoted to the reference, reading and lending libraries, not to mention the storing department basement-storing facilities, each of which presents a problem in itself.

Among the points much discussed by librarians were the relative claims of local and general illumination, the best methods of making use of reflection from light-colored walls and ceilings, and the best varieties of shades for local table lighting. One special difficulty which almost all librarians had experienced was that of effectually lighting bookshelves and gangways.

At the next meeting the discussion was resumed and the various points raised in the former discussion were dealt with from the engineer's standpoint. A special feature was the presentation of data regarding the conditions of illumination, consumption of energy, etc., in various London libraries by Messrs. Leon Gaster and J. S. Dow. It was shown that, excluding certain libraries in which the lighting was considered abnormal and clearly unsatisfactory, the general value of the illumination on the reading tables was in the neighborhood of 2 ft.-candles, so that in attempting to frame a standard of what was necessary there was already a good practical record on which to base suggestions.

Some curious anomalies in the specific consumption in watts per square foot in different libraries were presented, and it was pointed out that in some cases in which this figure was highest the resulting illumination was least satisfactory. One of the best-lighted libraries, that in the British Museum, has, however, a very high consumption, but this is due mainly to the use of about 300 table lamps, each equipped with a carbon-filament 16-cp lamp, over the immense floor of the library. The diameter of the great dome in this library, it may be mentioned, exceeds that of St. Peter's at Rome.

One point which certainly had not received enough attention in many of the libraries visited was the importance of avoiding glare. Many typical arrangements of lamps and shades were exhibited, and it was shown that many of these are not only very ineffectual as a means of distributing light, but that they screened the filaments of the lamps in a most imperfect manner so that the eye was continually being dazzled once it was raised from the book. Stress was laid by many speakers on the desirability of employing half-frosted lamps or else concealing the filaments completely by suitable globes and reflectors or by indirect systems of lighting.

A series of measurements of the distribution of illumination over the bookshelves was also presented, and it was pointed out that the light was most unevenly distributed and that a mere fraction of the total flux of light properly applied would have sufficed. There were a number of suggestions as to how greater uniformity might be obtained. Mr. T. E. Ritchie described some excellent results secured by inverted-arc lighting, and Mr. V. H. Mackinney exhibited a new type of metallic reflector designed to produce a perfectly even illumination on a vertical or horizontal surface and to screen the eyes while doing so.

The relative merits of general and local illumination were fully discussed. From the lighting standpoint many of those present preferred a certain number of local lamps. The chief objection to this method of lighting from the librarian's standpoint is that it entails practically fixing the positions of the furniture. It was also contended that in many cases, as, for example, a public reading-room, the "subdued" impression caused by local lighting is not what is wanted. A room of this kind must be cheerful and stimulating so as to attract passers-by, many of whom are of the poorer class, and provide them with something that is a pleasant contrast to their usual comparatively dull surroundings. In passing, another important suggestion from the librarians may be noted, namely, that lighting contractors should make provision for bright light outside the building. The main function of a public library being to attract the casual passer-by, it is most essential that the building should stand out from neighboring ones so that people in the street may have no difficulty in knowing that it really is a library.

From this discussion the following conclusions seem to represent the general view:

First, that a reading illumination of at least 3 ft.-candles is needed for modern print; for special work, such as the examination of finely printed patent specifications, engineering drawings, manuscripts in Oriental languages, parchments, etc., a higher value of at least 5 ft.-candles or more, according to the fineness of the detail and reflecting power of the material on which it is written, is needed.

Second, that no unduly bright source of light should be visible in the normal field of view in libraries; either some form of indirect lighting should be employed or the lamp should be effectually concealed in a suitable globe or reflector.

Third, that in general the ideal system of illumination for a

library will be found to consist in a combination of diffused and soft general illumination with local, well-shaded table lamps. The nature of the interior must, however, be borne in mind. It is suggested that local lamps are desirable in student or reference libraries, in which the attention is concentrated on serious work. This method is employed in the British Museum, Fulham Library and other successfully illuminated libraries. However, the contrast between the brightness of the printed page and the surroundings should not exceed 100 to 1. In reading-rooms where most of the seats are occupied simultaneously and light reading is indulged in a cheerful general illumination is usually satisfactory. The data accumulated suggest that local lighting is no more expensive as regards running costs than general lighting, though it may be more expensive to install.

Fourth, that the methods of shelf lighting usually adopted in London libraries call for improvement. The chief desiderata are the production of more uniform illumination and better means of screening the eye from the direct rays of light. It is suggested that experiments should be made with a view to developing more satisfactory forms of fixtures for shelf lighting. Meantime it seems to be generally accepted that the average illumination on shelves should be about 1 ft.-candle to 1½ ft.-candles.

Fifth, further data are also needed regarding the best height of standards for table lamps, types of shades to be used, etc., and the desirability of producing uniform illumination. Some have held that the table ought to be quite uniformly illuminated, but other librarians urge that it is not needful to do this as spaces must necessarily be left in many cases for readers to place their books beside them for reference.

The second important discussion embarked upon by the Illuminating Engineering Society, namely, school lighting, was again productive of an excellent discussion, and again it was found necessary to adjourn the discussion to a second evening.

On this occasion the same plan as previously was adopted, namely, devoting one evening to the treatment of the standpoint of the medical authorities, while the second was given up to more purely engineering aspects of the matter. The discussion was opened by papers from Dr. James Kerr, medical officer to the London County Council, on "Daylight Illumination," and Dr. N. Bishop Harman on "Artificial Illumination." Representatives from the following bodies were invited and took part in the discussion: The Medical Officers of Schools Association, the London Teachers' Association, the Association of Technical Institutions and the Association of Teachers in Technical Institutions. Representatives of the engineering department of the London County Council also took part in the discussion, and it was generally agreed that the discussion would be very beneficial in bringing home the need for good lighting in influential quarters.

As on the previous occcasion, Messrs. Gaster and Dow presented a collection of data regarding the conditions of illumination met with in elementary schools, higher public schools, and technical and other colleges. Similar data regarding the results of gas lighting and arc lighting were put before the meeting by Mr. F. W. Goodenough and Mr. T. E. Ritchie respectively.

As regards artificial illumination the discussion followed a very similar course to that which prevailed in the case of library lighting. The method of lighting adopted in the most recent London County Council schools was spoken of with approval, but some of the older schools visited were found to be poorly lighted in many respects. In some cases old carbon-filament lamps, imperfectly shaded, were used, and, although the watts per square foot were as high as 1.2, the illumination was not more than 1.5 ft.-candles and the general arrangement of the lamps with regard to the desks was unsatisfactory. In some of the older public schools visited (which included in their number the famous school at Harrow) the lighting was good, but in others antiquated forms of burners and feeble illuminations down to 0.5 ft.-candle prevailed. A collection of sketches of fixtures encountered in different schools was shown at the meeting. Some of these were crude in the extreme.

There was also much discussion regarding the arrangement of the lamps and benches. In many schools and colleges the lamps are so arranged as to be extremely trying to the eyes of those at the back. In this respect technical colleges are specially criticised, for it was pointed out that they have a special interest in lighting and ought to lead the way in the direction of showing how the illumination of lecture theaters, drawing offices, etc., ought to be carried out.

One point emphasized by many speakers in the discussion was the extraordinary variation in daylight at different parts of a room. This might easily prevent a student in some remote corner receiving enough illumination to read by. It was suggested that the old formula to the effect that the available window area should be one-fifth of the floor area could not be applied to deep rooms, and Dr. Nash suggested that the facts brought to light in this discussion might lead to a movement in favor of narrower rooms, with a minimum depth from the window, in the future. The London County Council has already adopted the plan of insisting on smaller classes and aiming at a standard size of room, about 20 ft. square.

The electrical contractor is often at a loss to predetermine what the artificial illumination in a building is going to be, and it is probable that the architect is often quite as much at sea in estimating beforehand the daylight illumination. Yet there are available data regarding the sky-brightness at different times in the year which should enable it to be calculated for a given interior for which the exact outlook and window area are known, with very fair accuracy. The need for calculations of this kind before a school is built was emphasized by several speakers, who alluded to the value of the Continental plan of arranging for a joint discussion between the architect, the engineer and the school medical officer at an early stage in the design. A method of checking out what the distribution of daylight in a given schoolroom is likely to be was recently adopted by Professor Ruzicka, of Prague, based on the construction of a small model of the interior above which was placed a sheet of translucent paper, illuminated from behind, which served as an artificial sky. The relative illuminations at different points in the model interior could then be studied photometrically, and should give an approximate idea of those likely to be met with in the final building. However, the difficulty in most of these determinations is to allow for the obstruction of neighboring buildings. For instance, in the Harrow school old, heavily latticed windows are used, and in many cases the ratio of window area to floor area would appear unduly low, yet, owing to the fact that the school stands in its own grounds at the top of a hill, with free space all round, the daylight illumination is said to be exceptionally good.

One other special point on which there was some discussion was the need for special illumination of the blackboards and diagrams. For this purpose some form of reflector which completely screens the source but yet distributes the light quite evenly over a wide vertical area is needed. It was pointed out that most blackboards can be quite efficiently illuminated by the flux of light from a single 16-cp lamp if the light is properly distributed; yet, so inefficient are many of the methods of blackboard lighting in use, the amount of light spent on the blackboard is not infrequently as great as that expended on the lighting of the whole room and even under these circumstances the distribution of light is very uneven.

The average intensity of light in schoolrooms devoted to reading purposes is from 2 ft.-candles to 3 ft.-candles. This is put forward as evidence of the reasonableness of the expectation that educational authorities should provide at least 3 ft.-candles for reading purposes and not confine themselves to the old 1 ft.-candle as the absolute minimum. However, it was pointed out that in many of the trade schools even 3 ft.-candles is not enough in view of the specially fine work performed. For example, when sewing with dark material and dark thread is undertaken even 10 ft.-candles is none too much.

Among the different types of schools described there was an interesting variety. Classrooms devoted to laundry work, cooking, art, coppersmith's work, etc., were referred to, and it appeared that the order of illumination in such cases was almost invariably higher than for ordinary classwork. For example, in the Arts and Crafts School of the London County Council values of from 4 ft.-candles to 6 ft.-candles are usually provided, and indirect arc lighting is the general rule. But for jeweler's and other fine work local lighting up to 30 ft.-candles is provided.

Some of the chief conclusions to be drawn from this discussion might perhaps be expressed as follows:

First, no unscreened unduly bright sources should be visible in the direct line of sight from the desks or from the blackboard, otherwise either the students will have difficulty in seeing the blackboard with comfort or the teacher will be unable to watch them.

Second, for general reading purposes an illumination of at least 3 ft.-candles is desirable; for work that is specially trying to the eyes at least 4 ft.-candles should be provided.

Third, special local lighting is desirable for blackboard and demonstration table. It is recommended that special study should be given to the production of efficient forms of fixtures for this purpose and in selecting the best form of blackboard to give a dead-black mat surface.

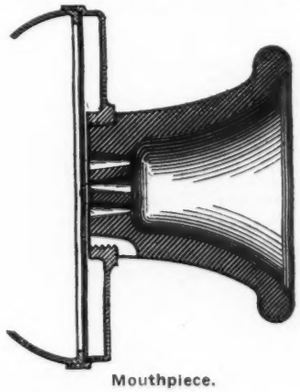
These two discussions may be taken as typical of meetings of the Illuminating Engineering Society in London and of the methods employed of inviting co-operation from those outside interested in the special problem under discussion. It is hoped that in these two cases the result will be to stimulate an interest in lighting on the part of librarians and school authorities so that experiments will be made along the lines suggested and new facts will be available when these matters again come up for consideration.

RECENT TELEPHONE PATENTS.

IMPROVED INSTRUMENTS.

One of the sources of expense of operation of a telephone plant is the breakage of receiver shells and transmitter mouthpieces. These have usually been made of rather brittle insulating material. It is not surprising, therefore, that some attention is being given to this subject. One of the results is the receiver casing and transmitter mouthpiece patented by Mr. L. Steinberger, of New York City.

The receiver casing of usual construction is provided with a



Mouthpiece.

metal ring at the base of the ear-cap and at the small end of the shell. These are somewhat larger in over-all diameter than the adjacent parts of the shell. If the receiver falls the metal rings receive the blow.

The transmitter mouthpiece is shown above. The outer edge or lip is thickened and is inclosed in a metal ring. The base is made solid and thus there is little tendency to break. The central aperture of the base is made conical with the small end toward the diaphragm, while in the surrounding ring of holes the flare is reversed.

The patent of Mr. J. Halldow, of Elyria, Ohio, describes an all-metal receiver shell. This is pressed out of thin sheet metal. Both shell and ear-cap are reinforced by threaded metal rings where they must be screwed together. The ear-cap ring is counterbored with an internal annular recess. The edge of the sheet-metal ear-cap is made the same as the counterbored groove and the edge of the cap piece is notched so that when the ring is pressed home the groove holds the ear piece in locking engagement. This patent is assigned to the Dean Electric Company.

Mr. C. R. Rogers, of Waverly, N. Y., has also patented a transmitter mouthpiece. He extends his transmitter casing forward of the diaphragm a distance equal to the depth of the mouthpiece. The lip of the mouthpiece is of the same diameter as this casing and the mouthpiece is seated within the casing. An antiseptic holder is formed upon the back of the mouthpiece, filling the space between the casing and the mouthpiece.

An especially sensitive receiver has been invented by Mr. H. R. Stuart, of Wheeling, W. Va. A flat circular box, with top and bottom of brass and sides of magnetic material, carries the diaphragm. Rising from top and bottom of the box at their centers are tubular cores which carry the receiver coils and which serve as sound passages. Four bobbins are arranged about the box, the cores being screwed into the side walls of the box. The outer ends of the cores carry U-shaped return pole pieces and these in turn are secured to plates carried upon the tubular central cores. The diaphragm is thus supported in a strong field of force.

CIRCUIT SYSTEM.

Mr. J. D. Holmes, of Pasadena, Cal., has obtained a patent for a common battery switchboard circuit system which he has assigned to the Dean Electric Company. The invention lies in the busy test features of the cord circuit. The operator's receiver picks up the test clicks from a tertiary winding upon the induction coil. Thus the receiver may be short-circuited at the test period and made insensitive to any currents existing upon the calling line to which the answering plug is connected.

AUTOMATIC SELECTOR.

In an automatic selector the contact arms may tend to stop in a mid-position. Thus the talking wipers must not make contact except when the steps are complete. Again the stepping circuits must be so maintained as to insure each step being carried to conclusion. In the selector of Mr. F. Schoenwolf, of Chicago, this is accomplished by having two sets of stepping wipers. One is associated with the back contact of the stepping relay and the off-contact wiper and the other with the front contact of the relay and the normal step wiper. If a step is incomplete when the stepping relay is released, as soon as the relay falls back the auxiliary circuit is closed to complete the action.

LETTERS TO THE EDITOR.

Regenerative Control.

To the Editor of Electrical World:

SIR:—In view of the title of my article in your issue of March 30 the point raised by Mr. T. J. Johnston in his letter published in your issue of April 13 seems most pertinent. It was my intention, however, that this article should be merely a part of a series of articles outlining the development of regenerative traction, with which I have been closely connected, and the results obtained in a number of tests, which results give an idea of the magnitude of saving which it is practicable to obtain.

I believe that I shall be able to satisfy Mr. Johnston that even after ample allowance has been made for added repair charges there will be a very substantial balance in favor of the regenerative equipment on top of interest and sinking fund

charges on the additional investment, even on the basis of a double series-parallel system with its relative complications, The return to the single series-parallel system will have a very slight influence on the saving and will reduce the complications. This will tend to make the figures I am preparing to submit still more conservative. When in addition (as shown in your issue of Feb. 2) Mr. Robert Lundell has developed a motor which weighs only 1400 lb., has an outside diameter of only 23 in. and has an efficiency of nearly 90 per cent at full-load rating of 50 hp (which rating is so conservative that experts admit that the motor should be rated at 60 hp) there is no doubt that regeneration has reached a stage where it is bound to revolutionize commercial saving.

Davenport, Ia. J. Gustaf V. Lang.

Rubber-Covered Wire Specifications.

To the Editor of Electrical World:

Sir:—I should like to make some comments regarding the chemical tests called for in the rubber-covered wire specifications of the National Fire Protection Association, as published in the April 13 number.

It is stated that five chemical tests should be made of the rubber compound, as follows: acetone extract, alcoholic potash extract, chloroform extract, ash and total sulphur. The sum total of these five tests should not exceed 80 per cent by weight of the total compounds—tests to be made according to the specifications of the Underwriters' Laboratories. The ash test should be supplemented by tests to determine the quality of substances other than vulcanized rubber which are combustible but not soluble in acetone, alcoholic potash or chloroform, and any such substances should be counted as ash.

It would seem that this would be more simply stated by saying that the compound should contain not less than 20 per cent of pure rubber, that is, rubber containing no resinous matter and that would yield no extract with acetone. Such a determination can be very easily made with the methods at present in use, and by determining the amount of rubber in the compound direct the errors in all the other determinations mentioned are eliminated. It would appear that it makes no difference whether the insulating compound has a high grade of rubber, such as Para, or contains the poorest grade. Of course, in using a low grade of rubber a little more will have to be added to make up for the excess of acetone extract. In fact, any kind of rubber could be used. The compound could have an acetone extract of 40 per cent or 50 per cent, and by reducing the amount of mineral fill such a compound would pass the test, while it is well known that for a compound to have lasting qualities and to give satisfaction it must contain a good quality of rubber having a low extract. The writer has made tests of insulation for years, and finds all this to be only too true. He has also found that where it is possible manufacturers will use a cheap rubber, putting in a little more than is required so as to obtain the correct percentage, and unless the relation of acetone extract to the rubber present is considered the purchaser will usually get a poor article at the price of a good article. The cheap rubber may be made to accomplish good results when it is new, but for some reason which is not well understood it has no lasting qualities. With the specifications as published one may never expect to get good rubber, while, on the other hand, insulation must be watched closely in order for one to be certain that he is getting the rubber for which he is paying.

New York. W. Jones.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Determination of Friction Losses in Induction Motors.—B. Zavada.—The friction losses of an induction motor are part of the mechanical load of the motor, and when the motor runs unloaded the friction losses together with the "additional losses" form the complete load. With decreasing voltage the power decreases in proportion to the square of the voltage and the motor is then heavily loaded by the friction losses and may even become overloaded by them, as is apparent from the increasing slip. Evidently all values obtained in this test when reduced to normal voltage must give points in the circular diagram of the motor. The power taken from the circular diagram and reduced to the original voltage represents the sum of the friction losses and the additional losses. The latter are negligible at low voltages. A numerical example illustrating the method is added.—*Elek. u. Masch.* (Vienna), March 5.

Three-Phase Series Commutator Motor.—R. Rüdenberg.—An illustrated translation of his recent German paper. The properties of the three-phase commutator motor with a series characteristic are here considered in an elementary way, the deductions being based on the ideal motor without leakage or losses. By this means a clear insight into the characteristics of the motor is obtained, and test results are added to show how nearly the practical motor agrees with the ideal.—Lond. *Electrician*, April 7.

Lamps and Lighting.

Alternators.—P. Bunet.—The first part of a paper giving "some remarks on synchronous and non-synchronous alternators." In the present instalment the author gives some theoretical points on the design and operation of high-speed synchronous machines and points out their difficulties.—*L'Industrie Elec.*, March 25.

Radiation from Electric-Incandescent Lamps.—G. Leimbach.—The author first gives the following definitions: Specific watt-consumption is the number of watts required to produce 1 mean spherical candle-power. Mean spherical total radiation is to be distinguished from mean spherical light radiation since the latter includes only the wave-lengths of the visible spectrum. "Relative radiation capacity" (relative Strahlungsvermögen) is the ratio of the energy of the total radiation to the total energy consumed and is, therefore, the greater the less heat is lost by conduction, etc. "Light effect" (Licht-effect) is the ratio of the energy of light radiation to the energy of total radiation and in all artificial lamps has a small numerical value. Selective radiation in the infra-red portion of the spectrum improves the light effect and also the "useful effect" (Nutz-effect)—that is, the ratio of the energy of light radiation to the energy consumed. Light effect and useful effect would be identical if no heat was lost by conduction, etc. Finally, "absolute specific light radiation" is the ratio of mean spherical light radiation in watts to the mean spherical candle-power; that is, what was formerly called the mechanical equiva-

	Carbon Lamp.	Nernst Lamp.	Tantalum Lamp.	Osram Lamp.
Ratio of energy of total radiation to total energy consumed, per cent	61.9	49.2	64.8	75.6
Ratio of energy of light to energy of total radiation, per cent	2.85	4.43	4.26	4.63
Ratio of energy of light to total energy consumed, per cent	1.75	2.17	2.75	3.50
Ratio of mean spherical light radiation in watts to mean spherical candle-power	531	340	449	418
Specific watt consumption in watts per cp	3.8	2.0	2.02	1.51

lent of light. This is not a constant, but depends on color and temperature. The author has carefully determined these quantities for various lamps, and compared them with the results of other experimenters, some of which, especially those of Wedding, are somewhat criticised. In the table on the preceding page the author's own results are given.

With respect to the "mean spherical light radiation in watts per mean spherical candle-power" it is not exactly clear what units are used in the author's figures. These figures—the fourth row of the table—are, therefore, only of relative value. The sequence of these figures shows, however, according to the author, that the temperatures of the tantalum and osram filaments are between the lower temperature of the carbon lamp and the higher temperature of the Nernst lamp. The figures in the first row show that there is considerable loss of heat by conduction, especially in the Nernst lamp, where 50 per cent is thus lost, against only 25 per cent in the osram lamp.—*Elek. Zeit.*, March 16.

Ultra-Violet Light from the Mercury Arc.—A. L. HUGHES.—An account of an experimental investigation, the chief results of which are as follows: The ultra-violet spectrum of mercury, investigated electrically, extends to about λ 1230. There is no appreciable radiation from the mercury arc between λ 1450 and λ 1780. The hydrogen discharge has relatively more energy in the short wave-lengths than the mercury arc. The velocity of the electrons due to one wave-length is independent of the presence of other wave-lengths in the beam of light.—*Phil. Mag.*, April.

Generation, Transmission and Distribution.

Insulation Resistance of Networks.—F. LEPRINCE-RINGUET.—The first part of a theoretical paper on the earthing of the neutral point and the permanent control of the insulation resistance of an alternating-current network. In the present instalment the author first discusses the analytical study of the distribution of the potentials in an alternating-current network by means of voltmeters inserted between each pole and earth. He shows how the constants of the network can be found from the readings of the voltmeters, especially insulation resistance and capacity. The article refers both to single-phase and three-phase systems. The paper is to be concluded.—*La Lumière Elec.*, April 1.

Metallic-Filament Lamp.—A note on a recent British patent (5388, March 23, 1911) of the Westinghouse Metal Filament Lamp Company and A. Lederer. Metallic filaments purchased from manufacturers are further decarbonized by heating in an atmosphere of pure hydrogen only. This permits of the amount of carbon present being reduced to 0.04 per cent.—Lond. *Elec. Eng'ing*, March 30.

Traction.

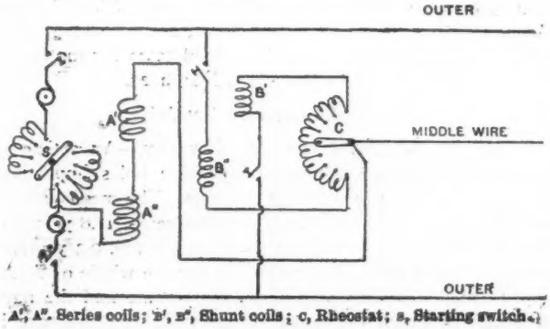
Frequency for Heavy Traction.—K. PICHELMAYER.—An article on the choice of the most suitable frequency for heavy traction. The author believes that a frequency of from 15 to 17 should be used, preferably a frequency of 16⅔.—*Elek. u. Masch.* (Vienna), March 5.

Installations, Systems and Appliances.

Gas and Electricity Supply in Germany.—MEYER COSCHÜTZ.—The change of Germany from an agricultural into an industrial country has been accompanied by a rapid extension of the uses of electricity. Practically all cities with 20,000 inhabitants or more are provided with electric-supply stations, and much attention is now being paid to building electric-distribution and transmission systems in rural districts. On the other hand, the gas industry is also very active and recently gas plants have made progress in districts which had been supplied with electricity for a considerable time. This has been the case especially where mistakes had been made in the equipment of the electric plant or where the rates for electricity were too complicated for the average consumer. Moreover, for cooking gas is still used almost exclusively. Cheap and reliable electric cooking apparatus should be developed and a low rate should be charged for cooking by electricity. To permit extended use of electric lighting by very small consumers a flat rate should be charged.—*Elek. Zeit.*, March 16.

Electricity Meters.—An account of the extended discussion which followed the recent paper of Ratcliff and Moore before the (British) Institution of Electrical Engineers. Various speakers referred to the question whether amp-hour meters, as generally favored in Great Britain, or watt-hour meters, as preferred in the United States and Continental Europe, are preferable. A. E. Jepson said that if ampere-hour meters are used and the voltage is slightly above normal, the loss of revenue resulting would soon pay for the extra cost of watt-hour meters. The testing of meters at a certain temperature is important, since the usual temperature of 60 deg. Fahr. is too high. W. Grant said that a consumer on a lighting circuit is supplied with energy at a definite declared pressure, and if the pressure rises above the normal he did not see that the supply authorities could legitimately charge for the excess due to the rise. W. Cramp thought there is some tendency among electrical engineers to strain after too much accuracy, not that a meter could be too accurate, but simply that obtaining the last 0.5 per cent might cost too much. The accuracy of electricity meters is already far in advance of anything met with in the gas world. It seemed almost hopeless to expect alternating-current meters to be very accurate. As regards the question of stray fields, it had always been a wonder to him that manufacturers do not construct their permanent magnets of such a shape that the yoke of the magnet shields the poles. This would largely avoid the errors existing at present. He thought that the reason for the accuracy of the Aron meter under very varied conditions is largely the fact that the timing mechanism is driven independently of the mechanism which registers the energy. E. E. Sharp referred to the question of ampere-hour versus watt-hour meters, and gave results of tests made by putting watt-hour and ampere-hour meters in series over periods up to twelve months. The readings showed only such small differences as one would expect between any two meters of the same type. W. Lawson said his experience with the electrolytic meter to a large extent refuted the wholesale condemnation of the authors. Of the 800 electrolytic meters installed in Birmingham only 2 per cent have been returned as defective. The figures should be compared with 8.9 per cent for mercury motor ampere-hour meters out of 2700 installed during the last four and one-half years. Electrolytic meters are largely used for small consumers, for whom it is undesirable to make a large outlay. They are cheap to buy and maintain. R. Amberton, in discussing the question of ampere-hour versus watt-hour meter, said that it is often assumed that the latter is a more or less perfect instrument. This is not the case, however. The authorities require a reasonably accurate meter at the lowest obtainable price, and at the present time this combination is best obtained with the ampere-hour meters.—Lond. *Electrician*, April 7.

Compound-Wound Balancer.—W. E. ROGERS.—An article on



A', A". Series coils; B', B", Shunt coils; C, Rheostat; S, Starting switch.

Fig. 1—Common Form of Balancer Connection.

the use and limitations of the compound-wound balancer, which consists of two compound-wound generators or motors coupled together mechanically, and in series electrically, across the outers of a three-wire system, for keeping the potential differences equal between the outers and the middle wire. Fig. 1 (in which *A' A"* are series coils, *B' B"* shunt coils, *C* a rheostat and *S* the starting switch) shows a common form of con-

nections for such a machine. As long as there are no serious faults on the outers this arrangement operates very well. But if one of the outers becomes "dead" to earth the neutral carries a current of short-circuit magnitude. This produces such a defect upon one of the balancing machines as to cause it to try to run away, while the other operates as an overloaded or short-circuited generator. It is, therefore, necessary to provide an automatic means of limiting the current returning by

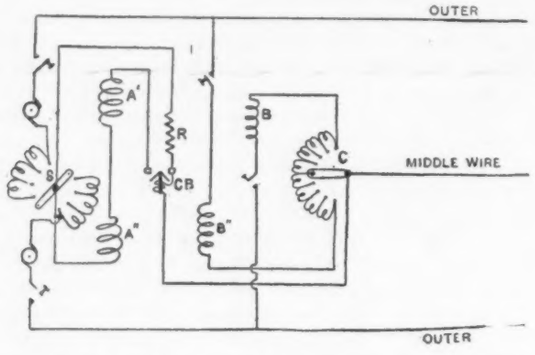


Fig. 2—Circuit Arrangement with Protecting Resistance.

way of the station earth plate. Even when the current is limited by a resistance in the earth connection it is advisable also to protect the balancer by having a low resistance *R* always in parallel with the series coils, as in Fig. 2, whch shows a very simple mode of wiring the balancer. The circuit-breaker *CB* is set to open at a desired predetermined value.—Lond. *Elec. Review,* March 31.

Energy Rate.—R. Arno.—A paper discussing his recent proposition of a rate in which a certain charge is made for the wattless power furnished to an insulation. This result is obtained by simply modifying the voltage circuit of an ordinary wattmeter so as to introduce a certain phase difference between the flux and the tension in the circuit. The quantity measured by such a meter is called "a complex charge," giving a measure of the sum of the real power and a certain fraction of the difference between apparent power and real power. By means of such a complex-charge meter and an ordinary wattmeter the power-factor can be directly determined. The system is discussed with numerical examples and its advantages are compared with those of other rates.—*Atti del' Assoc. Elettrot. Italiana,* July and August, 1910; *La Lumière Elec.,* April 1.

Energy Rate.—L. Choulet.—The conclusion of the long serial in which the author discusses under which conditions either one of the following three rates will be suitable: Either flat rate, or, secondly, a meter charge with a price per kw-hour determined by a two-term formula (taking account of both kilowatts installed and kw-hours used), or, thirdly, a meter charge with a single price per kw-hour. Finally, special rates for motor service are discussed.—*L'Industrie Elec.,* March 25.

Wires, Wiring and Conduits.

Impregnated Wooden Poles.—R. Nowotny.—An article giving statistical data on the life of wooden poles impregnated with copper sulphate in Austrian practice. The mean values of the life in nine different districts are 11.4 years, 15.8 years, 12.8 years, 14.3 years, 8.9 years, 12.3 years, 14.5 years, 9.3 years and 21.9 years respectively. The mean life for the whole of Austria is 12.8 years. The life depends on the climate and the nature of the soil in which the poles are planted. The average life of such poles in Germany is 14.5 years and that in France and in Holland 15 years.—*Elek. u. Masch.* (Vienna), March 5.

Electrophysics and Magnetism.

Relativity.—N. Campbell.—A paper on common sense in the theory of relativity. The author endeavors to show that this theory is not nearly so abstruse as most people think. He emphasizes the fundamental physical assumptions rather than the mathematical niceties of the theory. The assumptions made by the principle of relativity are stated and an attempt is made to render some of them more plausible at first sight. A difficulty connected with the composition of velocities is examined and found to be due to verbal confusion. The confusions introduced by the word "real" are discussed. The relation between dynamics and relativity is considered briefly.—*Phil. Mag.,* April.

Discharges in Gases.—A. B. Meservey.—To study the process of ionization in gases at very low pressure the author has made experiments on sparking in a non-uniform field. He employs the field between two concentric cylinders. For every value of the diameter of the inner cylinder two different sparking potential curves are obtained, corresponding to the two directions of the field. For smaller diameters the two curves cross near the critical pressure, and that for a negative inner electrode is higher on the side of the lower pressure, but they tend to coincide as the field approaches that between parallel plates. The minimum sparking potential depends upon the diameter of the inner electrode, and is always lower when that electrode is negative. The minimum sparking potential is always higher than that for parallel plates when the inner electrode is positive, while the lower values when the inner electrode is negative are below that for parallel plates. The lowest values obtained were 311 volts for air and 240 volts for hydrogen. The results obtained at pressures down nearly to the critical pressure may be explained on the theory of ionization by collision. Below that the results are entirely in harmony with the supposition that at these pressures some kind of radiation is produced by the impact of negative ions on the electrode under the action of a fairly strong force. In the second part of his paper he discusses the effect of a continuous discharge upon sparking potentials at low pressures.—*Phil. Mag.,* April.

Ionization by Alpha Particles.—T. S. Taylor.—An account of an experimental investigation of the ionization of different gases by the alpha particles from polonium and the relative amounts of energy required to produce an ion. The ionization curve obtained in various gases and vapors with polonium as the source of rays is of the general form $I = c\,(r - x)^{-1/2}$, where I is the ionization, c is the constant for any one gas depending upon the total ionization produced, and consequently upon the energy required to produce an ion in the given gas; r is the average range of the alpha particles in the cone of rays, and x is the distance from the source of rays. The agreement between the theoretical and the experimental curves confirms the assumption made in previous papers by the writer and by Greiger that the ionization produced by the alpha particle is proportional to the energy consumed. The values of the ratio of the total ionization produced by the alpha particle in different gases to the total ionization produced in the air as found by Bragg have been confirmed by a more direct process. The energy of the alpha particle consumed in the production of an ion depends upon the nature of the molecule ionized. It apparently requires less energy to produce an ion in the gases or vapors which have heavy or relatively complex molecules than it does in those gases of lighter or less complex molecules.—*Am. Jour. of Science,* April.

Insulation.—In the annual report of the (British) National Physical Laboratory attention is called to the importance of air spaces in insulating materials subjected to electric stress. The effect of such air spaces, when the stress is sufficiently high to cause ionization of the air, is to increase the energy loss in the insulation and consequently heating, and to promote the deterioration of the material. Experiments made on this point have led to an investigation of the very interesting and important question of the critical electric stress in air at the surface of a conductor. The method adopted was to measure by an electrostatic wattmeter the loss between a suspended wire and a concentric metal cylinder. The results of these experiments were in close agreement with those of E. A. Watson.—Lond. *Electrician,* March 31.

Resistance Wire.—A note on a recent British patent (14,743, March 30, 1911) of the British Thomson-Houston Company (General Electric Company of this country). An alloy which can be rolled and drawn and is suitable for resistance wire or

heating elements consists of 20 parts by weight of iron, 62 parts nickel, 12.5 parts chromium, 5 parts manganese and between 0.1 per cent and 0.4 per cent of carbon. This alloy oxidizes only very slowly at a red heat.—Lond. *Elec. Eng'ing*, April 6.

Units, Measurements and Instruments.

Resistances with Current and Potential Terminals.—G. F. C. SEARLE.—The first parts of an article in which the author points out that, although conducting systems with current and potential terminals have been in use for many years, the general theory of conduction through such systems has received little attention. The usual proof of the important theorem that current and potential terminals may be interchanged without affecting the potential difference on the main resistance involves the condition that the whole of any one junction is at the same potential. This condition is approximately satisfied in the case of a network of fine wires, but not in a "low resistance" or "shunt." In dealing with such a system proof is needed of the reciprocal relation which shall be independent of the form of the system. Helmholtz has given such a proof, and a simple direct one is due to Heaviside. Bromwich, employing Green's theorem, also gave a solution. Useful information regarding the properties of conducting systems with three and four terminals is obtained, and it is shown that a triangle of resistances may be replaced for all purposes by a three-rayed star of resistances. In the case of a four-terminal resistance one can construct even low-resistance systems such that the want of infinite conductivity at the junctions can produce no sensible error. The discussion of the design of such resistances shows the great advantage of connecting each current and each potential terminal to the main resistance by a rod or wire, the length of such being at least three times its greatest width. The resistance of such a system is very definite. In the case of low resistances capable of carrying currents of the order of 1000 amp slight changes in the connections at the terminal lugs have been found to produce appreciable changes in the potential differences in the main resistance. These defects are easily remedied. Potential "tongues" in sheet resistances are shown to be an advantage. For the comparison of four-terminal resistances with other resistances five methods are discussed, the most important of them being the Thomson bridge, which possessses an advantage not previously realized.—Lond. *Electrician*, March 31, April 7.

Electric Temperature Measurements.—J. RAUTENKRANTZ.—An illustrated paper describing the measurements of temperature with electric-resistance pyrometers, with thermoelectric pyrometers and with optic pyrometers, and the application of these different pyrometers in commercial practice. Resistance pyrometers are said to be suitable for temperatures up to about 900 deg. C., and are especially useful where measurements are to be made within narrow limits of temperature changes. The accuracy is higher than with the thermo-element. Thermo-electric pyrometers can be used for temperatures up to 1600 deg. C.; they have the advantage that no auxiliary source of current is required and that they are simpler and cheaper. The accuracy can be made pretty high if care is taken to keep the cold end at a constant temperature. Optical pyrometers are suitable for temperatures up to about 4000 deg. C.; they are not subjected to wear and tear, but they cannot be made recording. The accuracy of the three types in practical use when some care is taken is about 1 per cent. In the discussion which followed Satori mentioned that optical pyrometers cannot be used for measuring the temperature of metallic-filament lamps, and that they are strictly exact only for the so-called black-body radiation.—*Elek. u. Masch.* (Vienna), March 12 and 19.

Non-Inductive Resistance.—In the annual report of the (British) National Physical Laboratory it is stated that when high accuracy is wanted in methods of measuring inductance or capacity it is usually desirable that all the resistances should be as non-inductive as possible, and that their small "residual" inductances should be accurately known. Many different types of nominally non-inductive coils have been tested and it has been found that 10-ohm coils have commonly an inductance of from 0.3 microhenry to 5 microhenries, 100-ohm coils up to 15 microhenries and 1000-ohm coils to 500 microhenries. A box is under construction in which the self-inductance for none of the coils will be above 0.1 microhenry. In order to measure the inductances of such coils with a bridge and mutual inductometer use has been made of the fact that a copper and a manganin coil of exactly similar gage of wire wound side by side and of similar length should give equal inductances at ordinary frequencies, while their resistances are very different. By this principle a resistance box of constant inductance can be constructed.—Lond. *Electrician*, March 31.

Voltage Division.—P. LUDEWIG AND G. TEUCHERT.—In the calibration of voltmeters an arrangement is usually employed which permits an easy variation of the voltage at the terminals of the instruments. The source of emf is connected to the terminals of the resistance with one or two sliding contacts. It is evident that the voltage which is taken off from the two sliding contacts depends on the resistance of the circuit between these two contacts (that is, the joint resistance of the voltmeters in the case of a voltmeter test). A similar arrangement is used for medical purposes when a gradually increasing current is to be passed through the body of a patient. If the resistance between the two contacts from which the current is taken off is raised by equal amounts, the voltage between the two contacts will be raised by equal amounts only if the resistance of the system through which the current is passed is infinitely large. The author gives curves showing the variations from this limit rule if the resistance is not infinitely large, but has several different values.—*Elek. u. Masch.* (Vienna), March 19.

Peltier Effect.—F. W. JORDAN.—A description of a new method for measuring directly the Peltier effect.—*Phil. Mag.*, April.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—J. E. TAYLOR.—A paper read before the (British) Institution of Electrical Engineers. After referring briefly to the position and arrangement of the radio-telegraph station as regards freedom from extraneous noises, the author discusses local inductive disturbances, interference between stations, atmospheric perturbations and variations in the transmitting efficiency of the atmosphere. Suggestions are made as to the method of minimizing such interferences. In contrast with coupling methods of reducing interference, various plans of divided circuits have been proposed or used in which the impulses conveyed by one branch are annulled by those conveyed by the other, except to the extent necessary for the interpretation of the signals required. In these methods the required signals are "tuned in" as against tuning out undesirable impulses. One of these methods is S. G. Brown's "bridge" method. The basis of the bridge scheme is shown in Fig. 3.

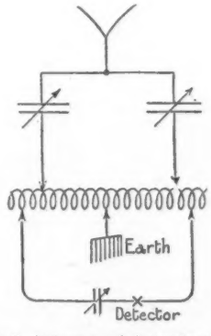


Fig. 3—"Bridge" Scheme of Interference Preventer.

If the two branches of the divided circuit are absolutely symmetrical all received impulses will divide equally and no effect will be produced on the detector, which occupies a position corresponding to the galvanometer in a Wheatstone bridge. A very slight disturbance of the balance by shifting the point of the earth-wire connection to right or left will determine signals on the detector from the branch best tuned to the received impulses. If these impulses consist of a sufficiently long train

of waves discrimination is effected between these and other impulses (even if of the same periodicity) if such other impulses are of a more rapidly damped character. It is not abundantly clear that devices of this kind possess advantages over, or involve any further principle than, that of reduced coupling. Greater promise of satisfactory elimination of disturbances and perturbations is afforded, in the writer's view, by the adoption of non-earthed directive aerials, at any rate so far as the shorter waves in practical use are concerned. For communication over short distances between fixed stations simple balanced directive aerials disposed to radiate in the line of communication give promise of very satisfactory results. These take the form of a vertical triangle, the apparatus being connected in circuit at the midway point of the base line, no earth connection being used.—Lond. *Electrician*, April 7.

Miscellaneous.

British Patents.—An abstract of a report of the (British) Comptroller-General of Patents, Designs and Trademarks in 1910.—Lond. *Electrician*, March 31.

Book Reviews.

American Producer-Gas Practice and Industrial Gas Engineering. By Nisbet Latta. New York: D. Van Nostrand Company. 557 pages, 247 illus. Price, $6.

Mr. Nisbet Latta's recent book on American producer-gas practice covers the entire range of making combustible gases from all types of fuels. Its fifty-page opening chapter gives practical directions for operating the various commercial types of producers with an exposition of the underlying principles which govern their action, data on producer linings, special grates, producer measuring instruments, etc. In view of some of the new Belgian producer grates with conical hearths, the author's strictures on angle-of-repose grates and management of fire may be taken somewhat liberally, but, on the whole, the chapter gives a very fair outline of the "state of the art" at present. In the next two chapters considerable space is devoted to types of scrubbers and cleaners, and works details. The chapter on producer types is exceedingly comprehensive and includes descriptions of the newest forms of lignite, straw, wood refuse, tan bark and bagasse producers, besides the usual coal types. The former are bound to become of more and more commercial importance in this country, as they already have in Europe. Gas power from industrial and agricultural refuse is the inevitable solution of the energy-production question, aside from that which can be indefinitely drawn from forest-protected water-power sites. These same producers are also treated numerically in the chapter on solid fuels, which gives, besides the yields from all grades of coal, data on the wood-refuse fuels in heat units per pound and cubic feet of gas obtained in practice per pound. There are four chapters devoted to the movement of gases, their physical and chemical properties and gas analysis. The chapter on gas engines is not very exhaustively treated, since the subject is *per se* matter sufficient for a separate work. The matter treated in the succeeding chapters on industrial gas applications, covering forge-shop and steel-plant ovens, gas-fired steam boilers, gas-burnt lime and cement kilns, brick kilns and iron-heating furnaces, etc., gives data not easily obtainable outside of a large technical library and will be found of much use in general practice for the industrial engineer. The subject of preheating air by stoves and economizers is gone into in a succeeding chapter, and, as in all the rest of the work, practical data of temperature and results of tests are given along with the descriptions of apparatus. The final chapters are assigned to useful information on heat radiation, temperature, pyrometry, flues and chimneys, masonry construction and tables likely to be of use to the engineer engaged in this class of work. Having such pertinent matter at hand in a single volume will save considerable searching through the usual pocketbooks, etc., wherein these figures are also to be found, but only after a long and exasperating search through several volumes.

Electric Wiring. By Joseph G. Branch. Chicago: Branch Publishing Company. 272 pages, 93 illus. Price, $2.

The question-and-answer form of presentation makes unwieldy some of the useful material on wiring subjects given in this work. The subject matter is quite elementary, but the discussions appended to various sections of the text of the National Electrical Code make this part useful to those seeking a better understanding of the Underwriters' rulings. The scope of the book is also amplified by digressions into the first principles of generating machinery, alternating currents and outside-line construction.

Thermodynamique et Chimie. By Pierre Duhem. Second edition, revised and enlarged. Paris: A. Hermann & Sons. 579 pages, 173 illus. Price, 16 francs.

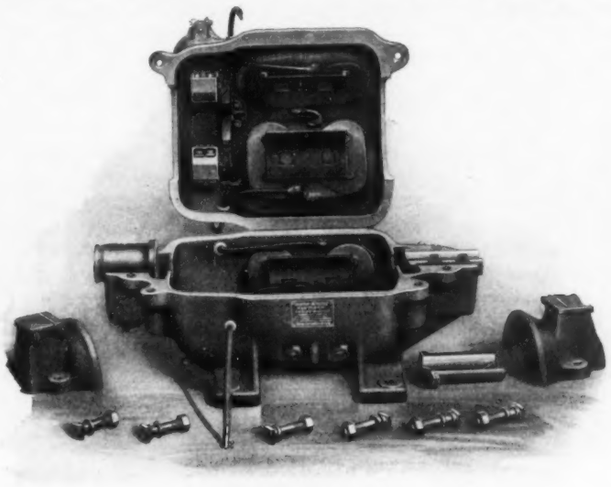
In engineering one is so accustomed to find thermodynamics treated as an applied science in relation to the properties of heat engines that it is surprising to find a textbook like this in which thermodynamics is treated as a pure science in relation to chemistry. Although thermodynamics is thus treated in this work, yet the discussion is of a very practical character, relating perpetually to observed chemical and physical data. In fact, one might say after studying this interesting volume that thermodynamics had here been dealt with by the author as a pure science in the manner of an applied science. The book is a masterly treatise on an obscure and relatively recent branch of physical chemistry. It indicates what a wealth of study and observation has been expended in recent years upon the borderland between chemistry and physics. It will be of much interest to advanced students of these two sciences.

New Apparatus and Appliances

DIRECT-CURRENT CRANE AND HOIST MOTOR.

The Western Electric Company has brought out a direct-current, series-wound, reversible, totally inclosed crane motor, available in ratings ranging from 24 hp to 240 hp. The motor is inclosed in a horizontally split steel frame, the upper half of which is hinged on one side. This construction totally incloses the motor and at the same time provides for quick and thorough inspection of all parts. When the motor is in operation inspection of the commutator and brushes is facilitated by means of large openings, having tightly fitted malleable iron covers, held in place by locknuts. The field coils are form wound, thoroughly insulated and rendered moisture-proof by impregnation with a special insulating compound. The armature coils are also form-wound and thoroughly insulated before being placed in the slots of the laminated iron core. The coils are held securely in position by means of strong steel wire bands and the sections of the coils projecting from the slots are covered by a strong canvas cover, which protects them from possible injury. The brush holders are mounted on a single yoke of simple but strong construction, and the brushes themselves are of treated carbon with riveted pigtails, held firmly against the commutator by a coiled steel spring. This coiled-spring construction and the fact that the box brush has a close fit prevent vibration and insure even wear. A heavy rolled-steel shaft of practically one diameter throughout is used. An equal extension is provided on

each end of the motor, so that the pinion and brake ends are interchangeable. Large and heavy bearings of cast iron and babbitt metal, lubricated by means of oiled rings and oiled grooves, cut in the linings, insure cool running under all conditions. When desired these motors can be equipped with a back gear, solenoid brakes and drum-type controllers with resistances for speed regulation.



Direct-Current Crane and Hoist Motor.

OPEN FEED-WATER HEATER.

The Cookson cast-iron heater shown herewith is provided with an oil separator of ample dimensions and has a cut-out valve within the separator to permit the heater to be cut out for cleaning and exhaust inlet and outlet connections in a direct line to permit the heater to be inserted in a vertical exhaust line without disturbing the pipe except to remove a short length to admit the separator. Separation is accomplished by change of direction of the current and expansion as follows: Exhaust steam enters the separator from the bottom and leaves through the outlet at the top. As the steam leaves the engine exhaust pipe it passes first through a tube projecting inwardly on the inlet flange and cut to open on an angle opposite the opening on the heater inlet tube. The steam is then divided by a "V"-shaped ribbed baffle cast on the under part of the heater inlet tube, which deflects the current to the separator walls. The steam currents therefore make nearly a right angle and must travel back again before they reach the exhaust outlet or the inlet tubes to the steam chamber of the heater. Meantime the oil and water particles, due to their greater weight, are dashed against the separator walls, which are ribbed their full length and breadth. Oil and water carried down these ribs fall into a well formed around the exhaust inlet tube, but out of the steam current. This well drains through a balanced floor trap and empties into the heater overflow pipe. All steam not going to the heater passes through a tube on the outlet flange similar to that on the inlet flange, but sloping downward and with angle opening cut in the opposite direction to that on the inlet, thus compelling the steam to travel in opposite direction to that in which it entered. Steam for the heater passes through the central horizontal tube, which is faced on the outer end to form a tight seat for a valve actuated from the outside of the separator. This valve may be opened or closed at will to regulate the inflow to the heater. It is claimed by the manufacturers that the cut-out valve construction is simple, inexpensive and easy to keep in order. The cold water comes in near the top of the heater to a spray box. A balanced valve in the water line regulates the flow of cold water. The trays are readily removed through the upper door. Gases liberated in heating go to the top of the heating chamber, from which a vent permits them to escape to atmosphere or into the exhaust outlet. The water is prevented from rising above a desirable level and provision is made for skimming the reservoir surface by an overflow plate that extends horizontally the depth of the heater and drains an even sheet of water into the overflow pipe. Suspended impurities which are too heavy to float are removed by the filter bed. The filtering material, usually coke, is supported by a removable perforated cast-iron plate which prevents any from getting to the lower or settling chamber. This lower chamber has at the bottom two flat surfaces sloping to a common gutter at the center. Any minute particles that pass through the filter naturally fall toward this gutter and are removed by opening the blow-off valve. Every part of this heater can be taken down with a monkey wrench, and as the parts are interchangeable any may be duplicated. Where there is no back-pressure valve in the exhaust line provision against pressure within the heater is unnecessary and the trap is replaced by a water seal. The Cookson heater is made by the Bates Machine Company, of Joliet, Ill.

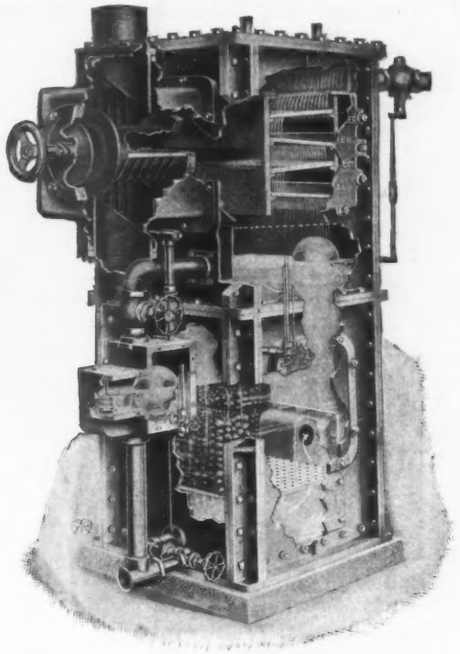


Fig. 1—Phantom View of Feed-Water Heater.

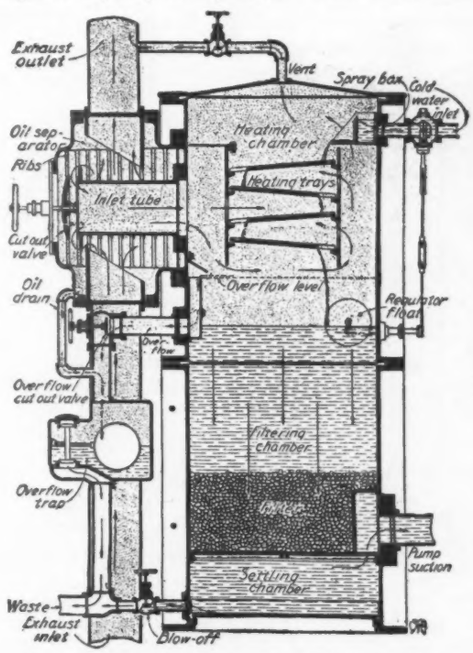


Fig. 2—Cross-Section of Feed-Water Heater.

AUTOMATIC FLOAT SWITCH.

The automatic float switch here shown embodies several features that render it desirable for the control of motors driving pumps that empty into reservoirs, or drain sumps, sewers, etc. The switch is operated by a cylindrical steel float which plays on a vertical rod between brass stops which are adjusted to the

Automatic Float Switch.

upper and lower water levels. When the float presses against either stop a U-shaped tripping lever attached to the float-rod engages a pivoted weight-arm and carries it upward and around past the vertical position. The weight-arm then falls, engages an arm on the switch drum shaft, and snaps the switch open or closed, according to the direction in which the weight-arm is thrown. A buffer receives the force of the weight-arm's fall. When the float-rod is attached to the tripping lever, as shown, the pump will be started when the float presses on the lower stop and hence is properly arranged for filling reservoirs. With the rod attached to the other side of the lever the switch is adjusted for drainage purposes, as the motor will be started when the float presses against the upper stop. The switch is of the drum type with renewable contacts and fingers. The switches are made in two styles—double-pole for direct current and single-phase alternating-current motors, and three-pole for polyphase motors. They are made by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.

PROTECTIVE OIL SWITCH.

The selection of the proper protective device is a matter of importance. If a device whose breaking capacity is just enough to take care of the present load is selected the future growth of the company will necessitate its replacement. This replacement may entail other considerations, not only on account of the cost, but also on account of the fact that larger devices necessarily take up more room, and often generating and substations are in such places that it is impossible to get the necessary increase of room. On the other hand, if devices are selected which will have an ultimate breaking capacity large enough for any possible increase of the station the amount of money invested is abnormal in relation to the protection obtained, as the devices are, necessarily, expensive for the amount of power they now control and the increased cost of investment may affect the price of energy. Protective oil switches for alternating-current work are at present divided into two classes —one for small stations and one for very large stations. The Condit Electrical Manufacturng Company, Boston, Mass., has, however, developed a line of oil circuit-breakers occupying a position midway between those for small stations and those for extremely large stations. These oil switches open upward as do the oil switches for the largest stations and have the same dimensions, outward appearance and mechanical features as the smaller ones. Due to this breaking upward and to other features of design, the switches are said to be capable of opening extremely heavy short-circuits on large stations. Switches are often installed on motors which are close to the generating station and unless a switch of large breaking capacity is used a short-circuit is likely to cause a great deal of damage. Fig. 2 herewith shows some of the details of the switch construction. It will be noted that the break takes place at the bottom of the can, that the cans are heavy and that there is a large space above the oil can to allow the gases to expand. This switch is made hand-operated and electrically operated, in ampere capacities as high as 3000 and for voltages as high as 60,000.

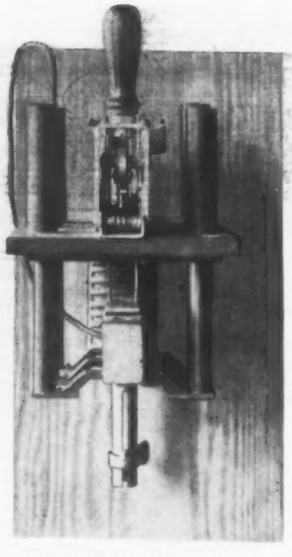


Fig. 1—Oil Switch Closed.

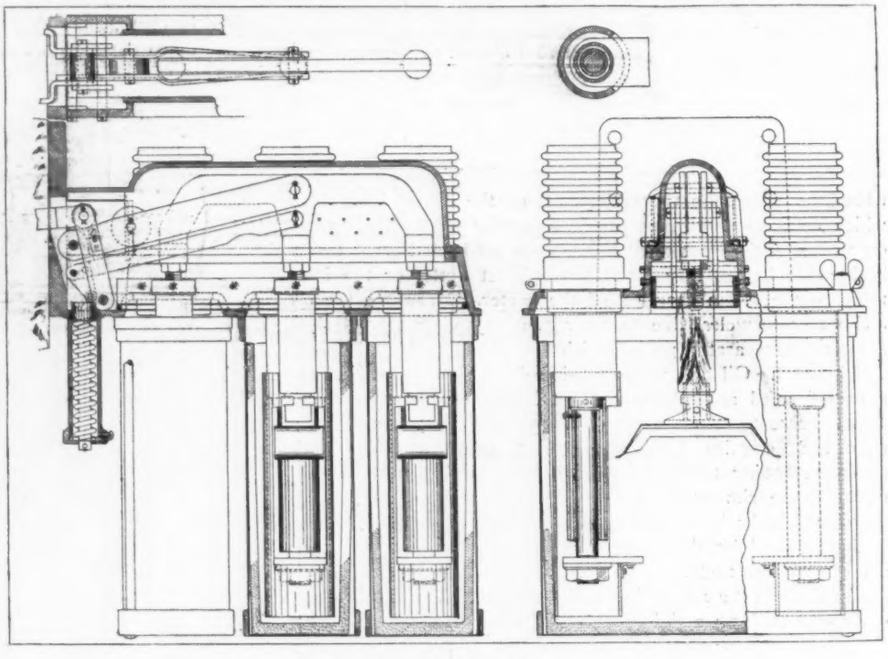


Fig. 2—Details of Oil Switch.

A NON-ROTATING SYNCHROSCOPE.

The synchroscope illustrated herewith is said to behave just like an ideally perfect rotating synchroscope but to have none of the disadvantages of the rotating type. The lamp method of synchronizing machines has the important advantage of being infallible in its indications; however, it is unfortunately very insensitive to differences in phase. For instance, a difference in phase of 16 deg. causes a change in voltage of only 1 per cent, and, therefore, a slight error in the judgment of the brightness of the light may result in a violent shock when the switch is thrown in. Furthermore, with lamps there is no way of knowing whether the incoming machine is fast or slow, and, therefore, much time may be lost in wrong manipulation of the speed.

Because of the infallibility of the lamp method of synchronizing, it is customary to install lamps with the rotating synchroscope to guard against any serious disaster; however, this expedient has the disadvantage of requiring the attendant to divide his attention between two objects.

Fig. 1—Phantom Front View of Synchroscope.

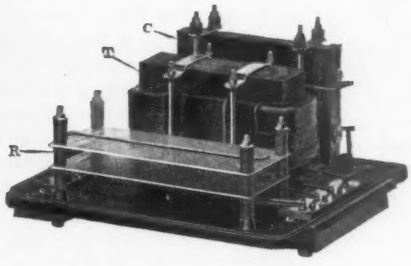


Fig. 2—Auxiliary Devices.

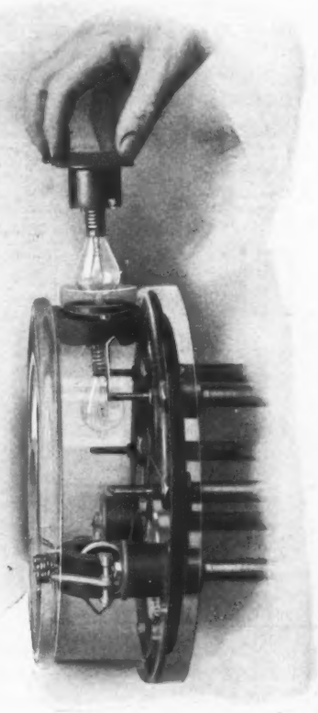


Fig. 3—Phantom Side View of Synchroscope.

The synchroscope here shown is so combined with a synchronizing lamp that its indications are visible only by the light of that lamp. The instrument proper consists of a new Weston type electrodynamometer movement essentially the same in construction as the single-phase switchboard wattmeter which was described in our issue of March 30, 1911.

The movable coil is connected in series with a condenser across the incoming machine, while the fixed coil, which is wound with fine wire, is connected in series with a slightly inductive resistor across the line. The pointer stands normally in the middle of the scale, which is made of translucent glass. The synchronizing lamp is mounted behind the pointer and when lighted throws a shadow of the pointer on the scale.

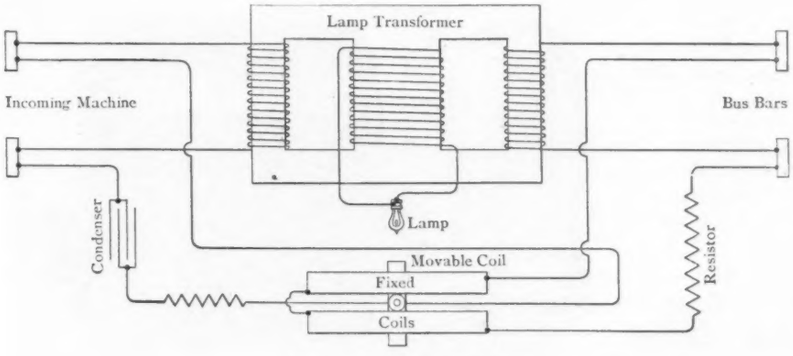


Fig. 4—Circuit Connections.

It is well known that a good electrodynamometer wattmeter will show no deflection when the currents in its fixed and movable coils are in exact time-quadrature; therefore, in this instance, because of the condenser, the instrument will accurately indicate when the emfs impressed across the coils are exactly in phase coincidence or in phase opposition, and the pointer will take up a definite position for each value of phase displacement depending upon the torque produced in the windings.

When the emfs of the machines to be synchronized are not of the same frequency the phase displacement between the two will change continuously through complete cycles of 360 time-degrees and therewith the average torque will rise and fall, first in one direction and then in the other, thereby causing the pointer to swing back and forth over the scale. Each swing of the pointer corresponds to a shift of the time-phase from quadrature lag to quadrature lead, or vice versa, and, therefore, just coincides with a period of light or darkness; that is, the pointer is seen only during every other swing and appears to rotate smoothly and silently in one direction. The direction of apparent rotation indicates whether the incoming machine is fast or slow, and the speed of rotation is a measure of the amount by which the frequencies differ.

When the frequency is right the pointer will come to rest and the lamps will remain lighted, and when perfect synchronism is attained the pointer will stand in the exact middle of the scale.

Just what goes on in the circuits of the instrument is shown in Fig. 5, which is based on two waves which have different frequencies. Assume the two waves at the top of the diagram to be the emf waves of two machines to be synchronized, then these waves also represent the currents in the primaries of the lamp transformer and the resultant (shown dotted) is the current active in the lamp. The shaded band shows where the current is not sufficient to light the lamp, and when the maximum extends beyond this band the lamp will glow. The periods of light and darkness are indicated

for this particular instance by the light and dark bands below the curves.

The middle set of curves is constructed from the top set by assuming the fast wave as belonging to the incoming machine; therefore the fast wave is advanced in phase a quarter period on account of the condenser. The instantaneous product of these two currents gives the torque active in the coils of the instrument. This torque has been calculated for the present case and is represented by the wave which bounds the shaded areas. The periodic reversal of the average torque is shown roughly by the sloping straight lines. This diagram shows that the pointer always moves from left to right during the light period when the machine is fast.

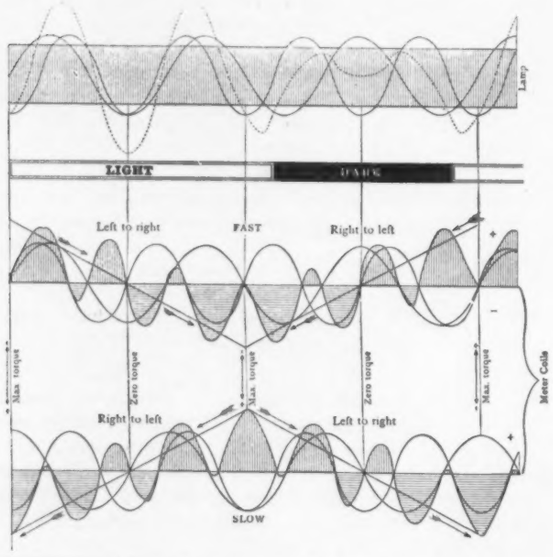


Fig. 5—Performance of Synchroscope.

The bottom group of curves is exactly similar to the middle set, except that the slow wave is considered as belonging to the incoming machine. In this case it is seen that the pointer moves from right to left during the period of light.

The chief advantage of the new synchroscope is its infallibility; however, its great accuracy is also of extreme importance, especially where large machines are to be synchronized. The independence of the indication of fluctuations in frequency and voltage is quite remarkable. For instance, a 60-cycle, 110-volt synchroscope when under test at from 40 cycles to 80 cycles per second and from 95 volts to 130 volts was still accurate within 1 deg. of true synchronism and permitted the coupling of machines absolutely without shock.

The construction and arrangement of the parts is shown in the illustrations herewith. The condenser lamp transformer and resistor are mounted in a separate box as indicated in Fig. 4.

The application of these principles to the operation of a synchronizing device is the invention of Mr. B. P. Romaine. The commercial form of the instrument as described above has been placed on the market by the Weston Electrical Instrument Company, Newark, N. J.

LIGHTING AND IGNITION SYSTEM FOR AUTOMOBILES AND MOTOR BOATS.

The "Matchless" electric lighting and ignition system for automobiles and motor boats, manufactured by the Esterline Company, Lafayette, Ind., comprises a positively driven, magneto-type direct-current generator, a storage battery and an automatic, self-closing, low-voltage release, overload, reverse-current controller. The generator is made to connect directly to the pump shaft in the same manner as an ignition magneto, without the use of a speed governor or speed-controlling device. It is supplied with complete ignition equipment, which can be omitted if desired, so that the ignition magneto can be retained or dispensed with as the user may desire. If desired the generator may be driven by gears or a silent chain in case the ignition equipment is not used.

The use of a machine without the usual speed-controlling devices, it is claimed, adds greatly to the reliability of the system, and the driving of the generator to a speed at all times in direct proportion to engine speed enables the makers to combine the lighting and igniting equipment in one outfit.

The use of a permanent magnet generator is made possible by the type of electric controller used. The controller has four distinct functions, as follows: To connect the battery to the generator when the voltage of the generator has reached the point where it will charge the battery; to limit the current through the battery to the normal charging rate when the generator is running at high speed; to disconnect the battery from the generator whenever the voltage of the generator is less than that of the battery; and to prevent the connection of the battery to the generator when the car is driven backward. The controller consists essentially of a die-cast metal case, over which is placed a permanent magnet with pole pieces projecting into the case and a pair of coils surrounding the pole pieces, but capable of motion relatively to the pole pieces. The force moving the coils is obtained by the reaction between the field of the magnet and the current in coils surrounding the projecting pole pieces. The moving parts of the controller are mounted on phosphor bronze leaf springs ½ in. wide set rigidly in an insulating block; these springs serve the double purpose of supporting the coils and leading the current to them. The coils simply float in a magnetic field. The operation of the controller is such that all electrical circuits are opened and closed at the instant the current is zero—that is to say, no currents whatever are broken, there is no sparking or burning of the brush contacts. With the car at rest or running at slow speed the connection between the battery and the generator is open, but when the voltage of the generator becomes sufficient to charge the battery the circuit between the battery and the generator is closed. Should the speed continue to increase, as soon as the charging current reaches the normal charging rate of the battery one of the coils comes into action and prevents the current from exceeding the normal charging rate. The space occupied by the controller on the dash is 2½ in. x 6 in. and it extends only 1½ in. from the dash; the weight complete is 2½ lb. The case is waterproof, dustproof and ornamental in appearance. There are four positions of the switch—lamps out of circuit for day running, side and tail lamps for city streets and use while the car is standing at night, head and tail lamps for touring, and all lamps in circuit.

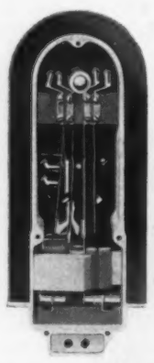


Fig 1—Automatic Controller.

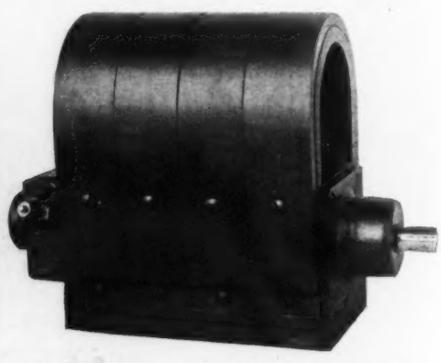


Fig. 2—Magneto-Generator.

All wiring is on the engine side of the dash, where it is not exposed to view. Openings are provided in the front of the controller for plug connections to an exploring lamp for use

in locating trouble, filling gasoline tank, etc. The generators are made in two sizes; the smaller size has a capacity of 7½ amp continuously at 6 volts and the larger machine has a continuous capacity of 12½ amp at 6 volts. The shaft is particularly heavy and rigid; the laminations of high-grade sheet steel are keyed to the shaft and the windings are embedded in slots in the core. After winding, the armatures are impregnated by the vacuum process, making them oil and moisture-proof. Hess-Bright ball bearings are used and are provided with oil chambers and oil-retaining rings, which effectually prevent the oil from entering the armature windings and commutator dust or dirt from the outside entering the bearings. The generator is geared or connected directly to the engine shaft or an intermediate shaft without any clutches, brakes or speed-controlling devices. Two carbon brushes are used in each holder. An inclosed junction box is supplied with each equipment. This box is of sheet metal with a removable cover and contains a small insulated panelboard with provision for the necessary fuses for each circuit and connections for all wires. It is stated that this junction box greatly facilitates the wiring of the car and gives an orderly arrangement to the circuits. The points for connection in the box and the wires leading in are labeled so that an inexperienced person can connect up the system. An 80 amp-hour battery is used with the small size and a 100 amp-hour battery with the large size.

MOTOR-DRIVEN AIR COMPRESSORS FOR GARAGES.

The motor-driven air compressor illustrated herewith is specially adapted to the needs of garages for inflating tires and for cleaning the upholstery and machinery of the cars.

The compressor is of the single-acting piston, single-stage

Fig. 1—Motor-Driven Air-Compressor for Garages.

compression type. It has two horizontal cylinders and vertical tubular valves. The latter have no springs and seat automatically by gravity and pressure. One intake valve and one discharge valve are located in each cylinder head, and the ar-

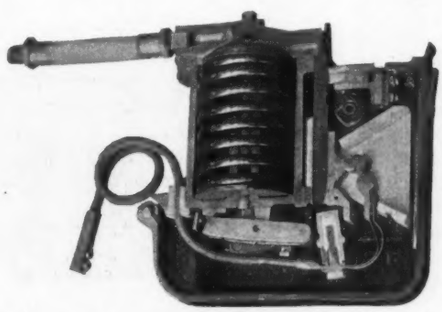


Fig. 2—Air-Compressor Governor Mechanism.

rangement of the intake air passages forces the incoming air through an air strainer, thus filtering the air and preventing trouble from dirt-clogged tire valves.

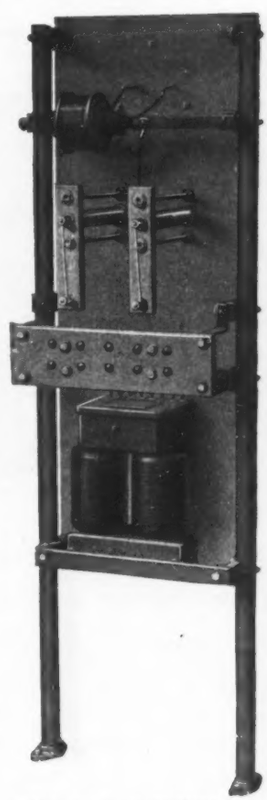
The motor drives the compressor through a herringbone gear. The gear is mounted on the crankshaft between the connecting rods, thereby equalizing the bearing on the teeth and reducing any tendency to vibration. In the design of the motors the armature and commutator diameters have been given dimensions most suitable for the required service, and all four poles are provided with field coils. The motors are rated on half-time basis—5 minutes on and 5 minutes off.

The air pressure in the tank is automatically regulated by means of a governor, which stops the motor when the desired maximum pressure is reached, and starts it up again when, by use, the pressure of the compressed air falls below a predetermined minimum. The governor is of the electrical circuit-interrupter type. It is made in two forms, for direct-current and for alternating-current supply. Both forms operate on the same principle, are of similar construction, and differ only in the number of electrical contacts, the direct-current form having two sets of contacts instead of one.

The above described equipment has been developed for the market by the General Electric Company, Schenectady, N. Y.

REGULATOR FOR METALLIC-FILAMENT LAMP CIRCUIT.

The resistance of the metallic-filament lamp increases as it gets hot, making it especially adapted for use on series circuits. On such circuits when lamps burn out and are short-circuited by their film cut-outs the increase in resistance in the remaining lamps prevents to a large extent an abnormal rise of current. That this is not the case with carbon lamps is well known. For example, suppose that after a severe storm 30 per cent of the lamps had burned out and become short-circuited. With carbon lamps and no regulator the rise of current in the remaining lamps would be 73 per cent, resulting in their immediate destruction. Had the resistance been constant the rise would have been 43 per cent, and with tungsten-filament lamps and no regulator it would have been cut down to about 25 per cent.



Rear View of Switchboard for Series Regulator.

The regulator shown herewith will keep the current practically constant for all ordinary conditions. Under abnormal conditions, as illustrated above, it will still limit the current to a perfectly safe amount.

Provision is made to reduce the current to normal value, if desired, while the large percentage of lamps is still out. In other words, the regulator is automatic and requires no attention. However, if a change in current is desired it can be handily accomplished.

The regulator is essentially an inductance in series with the lamps working in the secondary circuit of a transformer, having several taps for the accommodation of partial load conditions. The inductance is also tapped at various points, and these taps are brought to a gang-plug switch, making it very convenient to use any desired point. The switchboard, which enables the system to be handled in its most convenient manner, is a component part of the outfit, which has been placed on the market in this form by the Packard Electric Company, Warren, Ohio. The claims made for this system, which has now been in success-

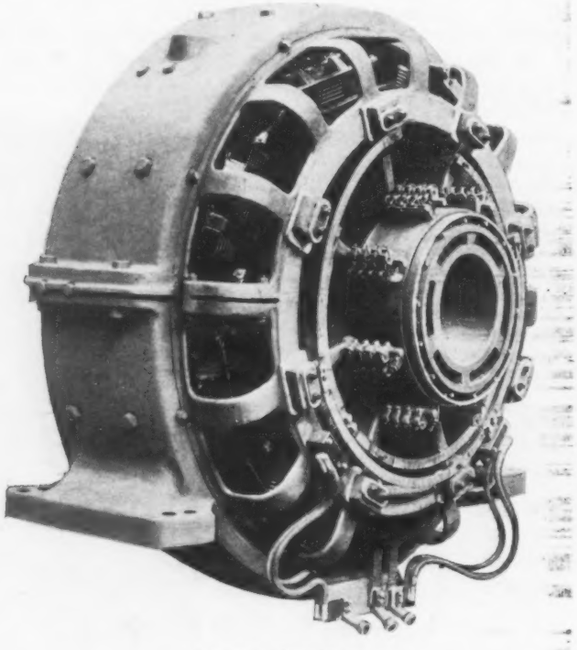
ful operation for over a year, are as follows: No moving parts; high efficiency and power-factor; normal power-factor on partial load; long life and dependable service. The apparatus also embodies the element of low cost.

INTERPOLE GENERATOR.

In the direct-current generator illustrated herewith ventilation has received particular attention. The design of all the windings is such as to give shallow coils, with the result that the heat in any part has only a very short distance to travel to the surface from which it is radiated. This, with a complete system of air circulation, insures an absence of hot spots and a high degree of uniformity of temperature. These features enable the generators to withstand heavy overloads without injury.

Most electrical troubles in a direct-current generator arise from faulty commutation, especially during overloads. They begin with sparking, which burns away the copper and brush, causing high mica, roughness of surface, flashing, break-downs in insulation and deterioration in brushes, brush holders and commutators.

In a non-interpole generator sparking is primarily due to a local magnetic field surrounding a coil which is being commutated. This field sets up an emf in the commutated coil, in such a way as to oppose the reversal of the current in the coil, and thus tends to cause sparking as the coil or commutator bar leaves the brush. This action increases with the current or load and is especially destructive to the commutator on heavy overloads. By advancing the brushes to bring the armature coils within the field near the tips of the pole pieces during commutation the sparking may be sometimes lessened.



Interpole Generator.

In the generator here shown the proper conditions for commutation are obtained by the use of small poles, interspaced between the main poles. The interpole windings, which are in series with the armature, serve to set up a magnetic field which annuls the effect of the field formed by armature magnetization and generates in the commutated coil an emf which assists the reversal of the current. Since the interpole coils are in series with the armature, the interpole field strength varies in proportion to the load and thus has the proper corrective effect at all loads. Experience has proved that with the interpole generator sparkless commutation is obtained under practically all conditions, from no load to very heavy overloads.

This machine has been developed for the market by the Westinghouse Electric & Manufacturing Company in ratings from 25 kw to 1000 kw. The line embraces generators wound for all standard voltages with speeds conforming to the best engine practice.

SEWING-MACHINE MOTOR-CONTROLLER.

In the sewing-machine motor-controller shown herewith a sliding arm is operated by means of a shaft which, when installed, is connected to an ordinary treadle by a rigid rod. Starting, stopping and varying the speed of small motors driving sewing-machines, saws, lathes, etc., by means of a foot treadle permits of using the hands for other purposes.

The entire mechanism, which is inclosed in a cast-iron case 6.5 in. high and 4.5 in. deep, is designed for installing under the machine board. It has been approved by the National Board of Fire Underwriters and is built to withstand the usage encountered in manufacturing establishments.

To start the motor the shaft is pulled down by pressing on the toe of the treadle. This causes a steel-contact disk to bridge the two lower steel-contact posts. A greater pressure moves the sliding arm over the contacts and increases the speed as desired, four separate speeds being provided. When pressure is released from the treadle, the arm and disk return to the "off" position, thereby opening the circuit. When quick stopping is desired, pressure is applied to the heel of the treadle, thereby forcing the sliding arm to the upper contacts and giving a strong dynamic braking.

Motor-Driven Sewing-Machine Controlled by Treadle Controller.

As the disk and contact posts are of steel, they become magnetized by the coils in the rear of the controller and a firm contact is secured when the motor is running. In stopping, the tendency is for the disk to remain in this position against the tension of a small spring mounted below the disk. When the upward motion of the controller shaft causes the tension of the spring to overcome the magnetism, the disk leaves the contact posts with a sharp snap, thus breaking the circuit quickly and preventing arcing.

This controller is made by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

Industrial and Commercial News

The Week in Trade.

CONTINUED dullness is the summary for another week of business. Few changes have taken place in the depression in the majority of lines, and manufacturing and selling interests, as a whole, seem inclined to discount all rumors of early activity. A moderate volume of business is being done, however, for immediate needs, but conservatism prevails in all transactions. While, on one hand, advices state that slackness in buying has resulted in low stocks which will require early replenishment, with a resultant increase in trade, there is also evidence that stocks in various lines have not been greatly reduced by reason of the dullness of the season, and that this creates no necessity for purchasing new supplies. Curtailment in many lines, notably dry goods and furnishings, is attributed to unseasonable weather. Hide and leather markets are dull, though buying seems more general. Demand for shoes continues to be fair. Textile lines are reported unchanged, with only light demand for cottons and woolens. Slight increase in building is in keeping with the period of the year. Hardware dealers are said to be mildly active, but the volume of trade is below normal. Net earnings of railroads are less than the returns for the corresponding period last year, and aside from a few car and rail orders the roads are not in the market for any encouraging amount of equipment. Interest is increasing in the outcome of tariff legislation. While the extent of time yet necessary for recovery from the effects of the depression of 1907 cannot be stated, there is a decided belief that progress is being made in readjustment and that trade will show marked expansion before the end of the year. Crop conditions are fully as encouraging as heretofore, although heavy rain is again reported in some sections as delaying the season. Collections are slow to fair, depending upon the locality. Business failures for the week ended April 20, as reported by *Bradstreet's*, were 233, as compared with 233 for the previous week, 193 for the same week in 1910, 247 in 1909, 254 in 1908 and 157 in 1907.

The Copper Market.

EXCESSIVE production and limited consumption continue to be the features of the copper trade, and no improvement is looked for until these factors become more closely related. Prices remain practically unchanged, with electrolytic on a 12-cent basis and standard quoted close to 11.70, with the market dull. Prices in Europe are declining slightly. A small speculative movement is reported abroad, together with transferring of stock from this country to European interests. Several heavy inquiries, aggregating 150,000,000 pounds, are said to have been received during the week at prices ranging from 12 to 12⅛ cents. Copper will not be affected to a marked extent in new tariff schedules, and despite reports to the contrary, increased business in this line is not looked for after Supreme Court decisions in the trust cases. Movements of large tonnages will be required to cause briskness in the industry. The relation between prices of copper securities and reports from the mines undoubtedly exerts as much influence on the copper situation as do reports of current sales. A closer relation between producing interests might result in curtailment of production. While figures for April are expected to show a decrease in the excess of production shown for March, the actual value of the figures is doubtful, by reason of falling off in imports and expected increase in exports, together with slight curtailment in output. At the present rate imports for the month will be between 12,000 and 14,000 tons, while exports, including April 24, were 24,800 tons, showing heavy increase over figures for the early part of April. The daily call on the Metal Exchange April 24 quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.70	11.80	.....
April	11.70	11.80	11.75
May	11.80	11.90	11.85
June	11.80	11.90	11.85
July	11.80	11.90	11.85

The London market, April 24, was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	54 11 3	55 3 0
Standard copper, futures	54 11 3	55 2 6

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.30c	11.67½c
London, spot	£56 15 0	£53 12 6
London, futures	57 12 6	54 5 0
Best selected	60 5 0	57 10 0

Industrial and Commercial Notes.

Electric Motors for International Bridge.—Tests will be made shortly on the equipment now being installed for operating the International Bridge, which crosses the new barge canal and the old Erie Canal at Buffalo, N. Y. The structure is of the swing type. Some 200 trains of the Grand Trunk system are to cross it daily. For this reason and since trouble has been experienced in this section by vessels breaking from their moorings in heavy winds, three sources of energy have been provided in order that the bridge may be opened and closed quickly and damage avoided. Each of the three systems is to be of sufficient size to operate the bridge independently of the others. A 100-hp Otto gas engine, direct-connected to a special generator, forms one source of energy. The second is a 100-hp motor-generator set, with a Crocker-Wheeler motor and a Garwood generator, energy being furnished at 2200 volts from the Niagara Falls Power Company. In addition to these is a Gould Storage Battery system, which will be used most of the time. About two and a half minutes will be required to open and close the bridge. The battery is to be of sufficient size to operate the bridge forty times without recharging. When this is necessary one of the other units will be used for the purpose. The installation has involved a large expense but has been considered justifiable in view of the necessity for certainty of operation.

Improvements in Flaming-Arc Lamps.—H. M. Hirschberg, president and manager of the Excello Arc Lamp Company, who has recently returned from his annual trip to Europe, states that, with recent improvements, the life of flaming-arc lamps has been increased from 70 hours to 125 hours, and that under very favorable conditions this has been extended to 150 hours. Mr. Hirschberg noted continued increase in the use of these lamps abroad, but found that the electrical trade and trade in general was rather quiet for this period of the year, reflecting business conditions in this country. As a matter of further interest, Mr. Hirschberg says that white carbon seems to be giving more satisfaction at this time than yellow and that his factories at present are shipping only the white carbon arc lamps. After June the factories will be able to make prompt deliveries in any quantities. Among other things Mr. Hirschberg visited the Berlin Electrical Show, which he found similar to but not equal to the last show held in New York City.

Smith Waterwheel Units.—The S. Morgan Smith Company, of York, Pa., has been awarded a contract by the Honk Falls Power Company, of Ellenville, N. Y., for an additional pair of waterwheels for the plant at High Falls, N. Y. This new unit will develop 1000 hp and will be a duplicate of the one furnished by the same company in 1910. The Honk Falls Company sells energy to the Ellenville Electric Company, Kingston Gas & Electric Company, Poughkeepsie Gas & Electric Light Company and to the Rondout Power Company. The Monument Mills, of Housatonic, Mass., have also placed a contract with the S. Morgan Smith Company for a pair of waterwheels for their plant at Glendale, Mass. These will be direct-connected to a Westinghouse generator and will have a rating of 775 hp. Energy will be transmitted to the Monument company's mills at Housatonic. One of these waterwheel units has been ordered by the Standish Worsted Company, of Plymouth, Mass.

Denver Improvements.—Henry L. Doherty & Company, who acquired the Denver Steam Heating Company about a year and a half ago, will spend nearly a half million dollars in improving the system. Most of this money will be used in bettering the mains. The Denver Gas & Electric Company has secured a city contract for lighting 500 magnetite lamps.

Foreign Trade Comments by American in Far East.—W. C. Redfield, second vice-president of the American Blower Company, who left New York last November on a trip to study conditions of trade in markets throughout the world, writes from Calcutta, giving information of value to American manufacturers and merchants interested in foreign trade. Mr. Redfield's letter, in part, is as follows: "I have now traversed Japan, the Philippines, Hong Kong, Java, the Straits Settlements and Burma to India, and I cannot say that thus far I have found any prejudice against American goods. Indeed, certain classes of American products have been everywhere in evidence. Among these are sewing machines, typewriters, toilet articles and soaps, locomotives (in Japan), petroleum products and others. These are precisely those that have been most carefully and steadily brought before and kept before the attention of buyers in these various lands. I ought also to add that American cameras and photographic supplies were seen everywhere except in Java; there no films of any kind could be had, only plates. I have run across neglect in packing even after attention was called to it. In one case oil stoves were formerly bought in America and the American product was concededly better, but, even after warning, the American goods were so badly shipped that one-half of one shipment arrived broken. Now the dealer buys in Europe and pays a higher price. He told me he did not want to do this but he had to, for American makers would not listen to him. Complaint is made that American houses trust young irresponsible boys to do their mailing instead of having some clerk of fair responsibility attend to this important service. The result is misaddressed letters so that responses are not received, and the regular habitual neglect to prepay proper postage causes extra charges. A large Boston house wrote to Manila on June 8, and on June 25 followed it up with a sharp letter insisting on an immediate reply. A New York firm referred an inquiry from Panama to its Manila agent. These are some of the things that handicap Americans. I do not find prices to be the obstacle. Several American manufacturers I have met tell me their prices are lower than their European competitors'. This is true of locomotives for example. Foreign trade does not essentially differ in its basis from domestic trade. A man in larger trade does not assume that Texas and Florida use the goods that sell in Maine; he finds out what are wanted or not wanted and acts accordingly, and this is all there is underlying export trade, but because it is just outside the immediate horizon and men are busy they often do not even inquire about it, and when they do and find it takes time and care and patience they take the near and obvious and let the other go."

Westinghouse Turbines.—Among recent sales by the Westinghouse Machine Company, of Pittsburgh, Pa., is a 5000-kw, 2300-volt, three-phase, 60-cycle turbo-generator to the Dayton Lighting Company. This unit is of the latest double-flow type and will run condensing on a Le Blanc condenser. Two 1000-kw turbine units of the single-flow type, furnished by the same company, are in operation at the plant. The Westinghouse Company has also recently received an order from the Weymouth Light & Power Company for a 625-kw single-flow, high-pressure turbine to be installed in the power house at East Weymouth, Mass. The turbine will use steam at 150-lb. pressure and will exhaust into a vacuum of 27 in., maintained by a Le Blanc jet condenser. Approximately $50,000 has been expended in improvements about the plant, which will make it one of the most up-to-date generating stations in Massachusetts.

Clarion River Power Company Organized.—Joseph R. Paull, H. W. Douglass, J. P. Fife and others, of Pittsburgh, are preparing to apply to the State Department at Harrisburg, Pa., for a charter for the Clarion River Power Company. The company plans to spend about $3,000,000 in erecting hydroelectric plants in Clarion County, Pa., for supplying energy to neighboring cities. Granting of the charter is opposed by the Pittsburgh Flood Commission and others who are interested in the building of storage dams across the Clarion River with a view to preventing floods in the Pittsburgh section. Residents of the townships in which the power company is applying for rights do not favor the charter and have signed petitions which are to be presented to the State Water Supply Commission. George H. Maxwell, executive director of the Flood Commission, said: "I notice that one of the parties applying for the Clarion River water rights has said that if a reservoir were built at the mouth of the river it would serve the same purpose as that advocated by the Flood Commission. I want to say that this is absolutely not so. Persons building such a dam for power purposes would have to keep the reservoir full at all times, and when there were floods water would run over its dams just as in other flood times. The Flood Commission would keep the reservoirs as nearly empty as possible that they might care for the increased flow of water, and have them filled only at the end of the flood season, when water would be stored to be used in the dry seasons. The opposition of the Flood Commission before the State Water Supply Commission at Harrisburg will be vigorous and determined. Pittsburgh was the first in the field and Pittsburgh should be given precedence by the State Water Supply Commission. If the plans of the Flood Commission are not carried out, Pittsburgh and other towns will lose $100,000,000 by floods."

General Electric Units for Water Company.—The Washington Water Power Company has placed an order with the General Electric Company for two waterwheel-driven generators, said to be the largest ever constructed. The units will be used in the Long Lake plant. They will have three-phase generators of the horizontal type, and will have a capacity of 13,000 kva., and will de designed to be able to carry a continuous overload of 25 per cent. They will operate at a speed of 200 r.p.m., and will generate current at 4000 volts. Four of these generators will eventually be installed at this plant. They are driven by I. P. Morris horizontal twin turbines each of 22,500 capacity at full gate, operating under a head of 170 ft. The potential of the transmission line will be 60,000 volts for the present, although the plant is designed for 110,000-volt operation.

New Power Stations in Texas.—In addition to the proposed hydroelectric plants on the Devil's and Pecos Rivers, in Texas, as mentioned in our issue of April 20, further developments are being planned on the Colorado River, in the vicinity of Kingsland. C. H. Alexander, of Dallas, who heads the company now building a hydroelectric station at Marble Falls, is active in the new project. The plant will have a rating of about 10,000 hp and will be operated in connection with the Marble Falls station. Energy is to be transmitted from these two plants to points within a radius of 150 miles. This system would include San Antonio, Waco, Austin, Georgetown, San Marcos and a number of smaller communities.

Sales of Mechanical-Draft Apparatus.—Recent orders taken by the Buffalo Forge Company, Buffalo, N. Y., for mechanical-draft apparatus of considerable size include, among others, orders from the Cambria Steel Company, Johnstown, Pa.; the American Smelting & Refining Company, New York. N. Y.; the Burgess Sulphite Fibre Company, Berlin, N. H.: Knickerbocker Portland Cement Company, Hudson, N. Y., and several export orders from its agents in Germany, Japan and South America. The Buffalo Forge Company reports the export business as particularly active so far this year and with excellent prospects of exceeding any former season.

Street-Lighting Equipment for Richmond, Va.—The Morris Iron Company, of New York, has been awarded a contract by the city of Richmond, Va., for furnishing 200 arc-lamp brackets to be used on the poles carrying transmission lines. The five-lamp ornamental tungsten clusters used on the main streets of the city were furnished by the Frederick Iron Works, which have been succeeded by the Morris Iron Company. The company has also received a number of orders for export, covering its outdoor fixtures, the most recent being from Limon, Costa Rica, for 100 cast-iron arc-lamp posts.

Catalogs and Prices Wanted.—Hugh G. Palmer, chief engineer of the Fox River Electric Power Company, Yorkville, Ill., requests that catalogs and prices relating to electric generators, motors, wire, fixtures, supplies, etc., be sent to him. It is said that the Fox River Electric Power Company is about to begin the construction of a $100,000 hydroelectric plant with generating station on the Fox River near Yorkville for supplying energy to Yorkville, Plano, Sandwich and other places.

General Electric Car Equipment Sales.—The Third Avenue Railway Company, of New York City, has ordered from the General Electric Company thirty-five motors and equipments for storage-battery cars on its system, and the Second Avenue Railroad Company, of New York, has contracted with the same company for ten double equipments, which are in addition to the 200 sets purchased in December, 1910.

Financial.

The Week in Wall Street.

DOWNWARD prices and occasional flurries of activity indicate the tone of transactions on the New York Stock Exchange since last report, with the market at present in dull condition after the depression of midweek trading. Sales of stock for the week were 1,692,933 shares, compared with 579,106 for the previous week. Repetition of various opinions as to causes of dullness and prospects for revival of activity has been frequent throughout the week, but, at best, there is nothing advanced which can be relied upon for immediate encouragement. Supreme Court decisions on the Standard Oil and American Tobacco cases are still withheld. Conjecture is divided as to whether decisions will be deferred until the October term, many interests believing that they will be ren-

NEW YORK.

	April 17.	April 24.	Shares Sold.		April 17.	April 24.	Shares Sold.
All. Ch.....	7½	7⅜*	300	Int. Met., pf.	52⅝	49½	11,000
All. Ch., pf..	29	26	900	Mackay Cos..	93½*	93½*	———
Amal. Cop...	62⅛	63	67,200	Mackay C.,pf.	76¼	74⅞*	316
Am. D. T...	20½*	20½*	———	Man. Elev...	139	137	284
Am. Loco...	37¼*	35¾*	750	Met. St. Ry.	15*	15*	———
Am. Loco. pf.	104½*	104	402	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	83*	83*	———	Steel, com...	76⅝	73⅞	388,000
Am. T. & T..	145⅞	145	3,090	Steel, pfd...	120	119	5,615
B. R. T.....	77⅞	76⅞	6,120	W. U. T...	72¾*	72*	1,120
Gen. Elec...	150½	150½	1,800	West'h, com..	65½	65	400
Int. Met....	18½*	17½	5,100	West'h, pfd..	117	117*	200

PHILADELPHIA.

	April 17.	April 24.		April 17.	April 24.
Am. Rys.....	44½	44	Phila. Elec.....	16¼	16¼
Elec. Co. of A.....	11¾*	11⅞	Phila. R. T.....	17¾	17⅞
Elec. St. B'ty.....	53¼	52	Phila. Trac.....	83¾*	82½*
Elec. St. B'ty., pfd.	30*	30*	Union Trac.....	45¾	45⅛

CHICAGO.

	April 17.	April 24.		April 17.	April 24.
Chi. City Ry.....	186*	186*	Chi. Tel. Co.....	120	122*
Chi. Rs., Ser. 1....	85*	85*	Met. El. Co.....	22⅛*	22⅛*
Chi. Rs., Ser. 2....	23½*	22	Met. El., pfd.....	68	67*
Com. Edison.....	126	125⅜	Nat'l Car.....	114½	115*
Chi. Subways.....	4¾	5	Nat'l Car, pfd.....	120	120*

BOSTON.

	April 17.	April 24.		April 17.	April 24.
Am. T. & T.....	145¾	145	Mex. Tel.....	3½*	3½*
Cum. Tel.....	150*	150	Mex. Tel., pfd.....	6½*	6½*
Edison E., Ill.....	284¼	285¼*	N. E. Tel.....	142	141
Gen. Elec.....	151*	151½	W. T. & T.....	19*	18*
Mass. E. Ry.....	16¾	16	W. T. & T., pfd....	94*	94*
Mass. E. Ry., pfd..	87	87			

*Last price quoted.
Shares sold for week, April 17 to April 22.

dered in May, rather than extend trade restriction by further uncertainty. There have been few developments in trade conditions to direct speculative interest in the stock market, and there is no doubt but that the narrow trading is mere manipulation. There is said to be more caution at present than heretofore on the part of commission houses in advising customers on action in the market, which is a reflection of the unsettled state throughout the Street. There is abundant evidence of large crops to assist the situation. Reports from agricultural districts are fully up to expectations based on earlier advices, although excessive moisture is said to be delaying matters in some localities. Increasing quietness is shown in the suspension of construction work in many sections, the closing of various mills and the shutting down of blast furnaces in several plants of the Steel Corporation. A cash gain of $9,400,000 is shown in the week-end bank statement, making a total surplus reserve of $39,800,000, which is approximately three times larger than the figures for the corresponding period of the previous year. There has also been an increase during the week in the volume of money coming into New York, and money will continue to be cheap throughout the month. Rates April 24 were: Call, 2¼ @ 2⅜ per cent; ninety days, 2½ @ 2¾ per cent. The quotations in the table are those of the close April 24.

Financial Notes

Earnings of General Electric Company.—The annual report of the General Electric Company for the year ended Dec. 31, 1910, shows marked gains over the business of the previous year. Total receipts from all sources were $74,707,689, against $54,102,051 for eleven months in 1909. Expenses were $63,134,601, including $4,661,175 charged to depreciation of plants, showing net receipts of $10,855,692, as compared with $6,493,671 for the eleven months ended Dec. 31, 1909. Surplus for the year was $5,641,324, while the total surplus is given as $23,022,706. Vice-president Lovejoy states in part: 'Sales billed and orders received during the past year were the largest for any year since the organization of the company. . . . Our high-voltage direct-current railway system has most satisfactorily fulfilled the requirements of interurban electric railways and steam railroad companies. The reliability of this system has been fully demonstrated by its continued successful operation on many electric and steam railways. A number of these railways have during the past year placed orders with us for additional equipments. Over 85,000 hp of our 1200-volt direct-current motor equipments are in service or on order. Our facilities for the manufacture of Curtis steam turbines have been taxed to the maximum during the past year. Increased facilities are being provided to meet the demand. Curtis steam turbines of our manufacture in excess of 2,600,000 hp are now installed or on order in the United States and abroad. Several turbine-generators of 27,000-hp rating each are now in process of manufacture for the Commonwealth Edison Company of Chicago and the New York Edison Company. . . . Our incandescent lamp business shows substantial growth. The rapid improvement in quality and efficiency of incandescent lamps—and more particularly the development of the high-efficiency metal-filament 'mazda' lamp—have added greatly to the popularity of incandescent lighting, enabling illuminating companies to give to their customers superior light at lower cost and to expand their business rapidly. The business of our foreign department was larger this year than for any previous year. This growth of our export business is due to the superior quality of our apparatus and further strengthening of our subsidiary companies and selling agencies in various parts of the world. We are constantly establishing new relations and seeking new outlets for our product."

Virginia Railway & Power Company Merger.—Plans are announced as completed for the merging of the Virginia Railway & Power Company, of Richmond, Va., and the Norfolk & Portsmouth Traction Company. Both companies control large interests in the lighting and traction properties in the State. The Virginia Railway & Power Company is capitalized at $12,000,000 and controls the water-power in the James and Appomattox Rivers, with generating stations at Richmond and Petersburg. In addition to controlling lighting and traction interests in these cities, the company lights neighboring localities, including Manchester and Northside. The common stock outstanding is $7,500,000, with $4,500,000 of 5 per cent preferred stock. The Norfolk & Portsmouth Traction, which owns the Portsmouth Electric & Gas Company, is capitalized at $6,000,000. In addition to these interests in Norfolk and Portsmouth the company leases the Norfolk Railway & Light Company. Outstanding common stock is given as $3,000,000, and there is also $3,000,000 5 per cent preferred stock. Reports of the Norfolk & Portsmouth Traction Company for eight months ended Feb. 28, 1911, show gross receipts of $1,400,079, an increase of $115,823 over 1910 figures; operating expenses were $788,088 and the net earnings $612,071, representing a gain of $52,930 over the figures for the same period of the previous year. The merger is planned to become effective July 1, 1911.

Telephone Opposition in the Southwest.—The Postal Telegraph Company is starting work on a new line in Texas, Louisiana, Mississippi, Arkansas, Oklahoma, Kansas and Missouri, to meet competition with the American Telephone & Telegraph Company, which controls the lines in the Southwest. A fifty-year contract which still has many years to run before expiration is now in force between the American Telephone & Telegraph Company and the Postal company, giving the latter an outlet in the territory; but Postal interests plan, nevertheless, to build their own lines. Representatives of the Mackay companies have been obtaining rights-of-way, and material for the lines has been distributed throughout a large part of the territory. Bell interests have been arranging, through the Southwestern Telephone & Telegraph Company, which is established in the section now entered by the Postal company, for a merger of the independent long-distance lines between Houston, Galveston, San Antonio and points in northern Texas.

Kings County Electric Light & Power Company Earnings.—Reports for March and for the first three months of the present year show continued increase in the business of the Kings County Electric Light & Power Company. Gross earnings for March were $378,802, an increase of $39,793 over returns of March, 1910; operating expenses were $192,954, an increase of $29,099, showing an increase in net earnings of $10,694. Gross earnings for the first three months of 1911 were $1,218,878, an increase of $147,238; operating expenses were $579,320, an increase of $87,561, and net earnings were $639,557, which is an increase of $59,677 over the earnings for the corresponding period of 1910.

United Railways & Electric Company of Baltimore Bond Interest.—Commenting on payment in June of the interest on the income bonds of the United Railways & Electric Company of Baltimore, Hambleton & Company state in part: "The interest on United Railway income bonds is payable June and December. It has to be earned in the preceding six months and declared by the board of directors semi-annually. As there are $14,000,000 United Railways income bonds, it takes $560,000 per annum to pay the full 4 per cent. Taking the income account, the extraordinary expenses, elimination of floating debt, etc., and estimating that certain items entering into charges in 1910 will not appear subsequently, there can be no doubt, as we view it, that full interest will be earned. The net income of the company last year was $1,226,853.54 (see *Electrical World*, April 13). From this was deducted $864,048.66 written off for extraordinary expenditures, leaving $362,804.88 to be carried to the credit of profit and loss. In looking over the items making up this total of $864,048.66, called extraordinary expenses, we find certain items that will not be a charge on the company in other years, and, therefore, in estimating what amount may be applicable to the payment of the interest on the income bonds these items may be eliminated. We also find that the company paid out of its earnings last year its total remaining floating debt, $375,000, and on account of current accounts, $32,500. We find also other items which may be eliminated, such as accrued taxes, $47,000, and settlement of park tax in Annex, $61,000. We find in the charge of extraordinary expenditures, improvements to power plant, $142,000, and annual rental payments made prior to Dec. 31, 1909, $135,000. As the company will soon begin to receive current from the Pennsylvania Water & Power Company, it will not be necessary to spend additional amounts on improvements to power plant, and the item $135,000 rental payments made prior to Dec. 31, 1909, will not appear again and can be eliminated. It certainly looks as if the United Railways will be able to pay full interest in cash on $14,000,000 income bonds."

Pacific Coast Power Company Preferred Stock Issue.—The Stone & Webster Corporation is offering $772,000 6 per cent cumulative preferred stock of the Pacific Coast Power & Light Company, at 100, to yield 6 per cent. The stock is redeemable at 110 and accumulated dividends. The company owns $4,125,400 par value of the stock of the Seattle Electric Company and $1,637,400 of the Seattle-Tacoma Power Company. Both of these companies have been in operation a number of years, and pay dividends of 7 per cent and 6 per cent per annum respectively. The Pacific Coast company is building a hydroelectric plant on the White River within 20 miles of Seattle and 15 miles of Tacoma. It is said that the site is capable of a development of 80,000 hp. The station now being built will have a rating of 27,000 hp.

Pennsylvania Railroad Tunnel Lease Extension.—The Public Service Commission for the First District, New York, has approved an extension of eleven months in the operating agreement between the Pennsylvania Railroad and the Pennsylvania Tunnel & Terminal Railroad Company, for which the former is now acting as agent. The Terminal company operates the electric division of the Pennsylvania Railroad between New Jersey and Long Island City by way of the tunnel under the North River. In the Terminal company's petition for an extension of the present lease, which expires at the end of May, it is said that the Pennsylvania Railroad has been unable up to the present time to obtain sufficient data to enable terms to be drawn up for a long lease of the property.

Report of San Joaquin Light & Power Company.—Increases in both gross and net earnings are noted in the annual report of the San Joaquin Light & Power Company, of Fresno, Cal., for the year ended Dec. 31. The company is consolidated with the San Joaquin Electric Company and owns and operates the Coalinga Water & Electric Company, the Power, Transit & Light Company at Bakersfield, Cal., and the Merced Falls Gas & Electric Company, of Merced, Cal. Gross income for the year was $1,052,462, an increase of $297,496, and the net income increased $188,493. After deducting interest charges, the balance represented a gain of $145,539 over the corresponding item for the previous year.

Automatic Telephone Service in Chicago.—It is asserted that the receivers for the Illinois Tunnel Company will have in service by June 1 the 20,000 automatic telephones necessary to comply with the terms of the company's franchise. It is estimated that the gross receipts from this telephone service will be about $1,500,000 a year, of which perhaps half will be net earnings. This is equal to 5 per cent on $15,000,000, but will not go very far on the $30,000,000 of bonds and receivers' certificates and the $45,000,000 of stock of the Chicago Subway Company, which controls the Illinois Tunnel Company. However, it is hoped to increase the number of telephones in use so that it will be much larger, ultimately, than the initial 20,000.

Syracuse and Utica Telephone Companies Sold.—Bell Telephone interests, represented by the Friendship Telephone Company, have secured control of the Onondaga Independent Telephone Company, of Syracuse, N. Y., and the Home Telephone Company, of Utica, N. Y., together with subsidiaries controlled by these companies. The transaction involved a cash payment of $1,250,000. This purchase has no connection with interests of the Rochester Telephone Company, which continues as an independent concern.

New Stock Issue by Niagara Falls Power Company.—The Public Service Commission of the Second District, New York, has granted permission to the Niagara Falls Power Company to issue $26,200 of capital stock. The proceeds of $22,900 stock formerly authorized are to be used for acquiring 491 shares of the Tonawanda Power Company. Of the 2500 shares of the capital stock of the Tonawanda company 2009 shares are now owned by the Niagara Falls Power Company.

Annual Meeting of Marconi Wireless Company.—Charles A. Terry, of New York, Major S. Flood-Page, of London, and Godfrey C. Isaacs, of New York, were elected directors of the Marconi Wireless Company of America at the annual meeting. They are to serve for five years. Other elections were: John W. Griggs, president; Guglielmo Marconi and John Bottomley, first and second vice-presidents.

New Jersey Utilities.—The New Jersey State Board of Public Utility Commissioners has approved the lease of rights and franchises of the Princeton Light, Heat & Power Company to the Public Service Electric Company, and the lease of the Burlington Electric Light & Power Company to the same interests.

Philadelphia Rapid Transit.—President Kruger, of the Philadelphia Rapid Transit Company, will hold a conference during the week with the finance committee of councils in connection with the $10,000,000 fund to be used for the rehabilitation of the company.

DIVIDENDS.

Cape Breton Electric Company, Ltd., semi-annual, preferred, $3 per share; common, $2 per share; both payable May 1.

Edison Electric Illuminating Company of Brockton, semi-annual, $4 per share, payable May 1.

Pacific Gas & Electric Company, quarterly, $1.50 per share, payable May 15.

Pacific Power & Light Company, quarterly, preferred, 1¾ per cent, payable April 25.

Sierra Pacific Electric Company, quarterly, preferred, $1.50 per share, payable May 1.

Union Utilities Company, of Morgantown, W. Va., quarterly, one-half of 1 per cent.

REPORTS OF EARNINGS.

Period.	Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
AMERICAN LIGHT & TRACTION COMPANY.					
March, 1911	$306,478	$8,357	$298,122	.....	.....
" 1910	275,348	9,421	265,927	.....	.....
GENERAL ELECTRIC COMPANY.					
Year, 1910	$74,707,689	$63,851,996	$10,855,692	.....	.....
" 1909	54,102,051	47,608,380	6,493,671	.....	.....
KANSAS CITY RAILWAY & LIGHT COMPANY.					
March, 1911	$656,062	$354,952	$301,109	$197,944	$103,165
" 1910	622,555	347,084	275,471	174,893	100,578
KINGS COUNTY ELECTRIC LIGHT & POWER COMPANY.					
March, 1911	$378,802	$192,854	$185,947	$113,977	$71,970
" 1910	339,008	163,754	175,253	103,322	71,931
NASHVILLE RAILWAY & LIGHT COMPANY.					
March, 1911	$156,961	$95,379	$65,582	$38,079	$23,503
" 1910	149,276	87,720	61,556	38,168	23,389
NEW ORLEANS RAILWAY & LIGHT COMPANY.					
Year, 1910	$6,245,223	$3,521,738	$2,244,843	$1,601,554	$643,289
" 1909	6,034,325	3,328,901	2,232,243	1,571,769	660,474
NORFOLK & PORTSMOUTH TRACTION COMPANY.					
8 m., Feb., 1911	$1,400,079	$788,008	$612,071	$500,918	$111,152
" 1910	1,284,256	725,121	559,135	513,140	45,994
RIO DE JANEIRO TRAMWAYS, LIGHT & POWER COMPANY.					
Year, 1910	$10,960,180	$5,567,088	$5,433,576	$3,096,433	$2,337,143
" 1909	7,527,559	4,459,252	3,438,495	2,888,887	1,149,608
SAO PAULO TRAMWAYS, LIGHT & POWER COMPANY, LTD.					
Year, 1910	$2,949,293	$962,337	$1,986,955	$383,862	$1,603,093
" 1909	2,439,486	846,627	1,592,859	371,986	1,220,873
UNITED RAILWAYS OF ST. LOUIS.					
March, 1911	$982,271	$692,497	$293,245	$229,545	$63,700
" 1910	972,494	705,876	270,297	233,708	36,589

General News

Construction News.

CHICO, CAL.—Preparations are being made by the Pacific Gas & Electric Company and the Sacramento Valley Power Company for the construction of a conduit system in Chico, work on which will begin in the near future.

DORRIS, CAL.—The Siskiyou Light & Power Company has applied to the Board of Trustees for a franchise to supply electricity for lamps and motors in Dorris.

HAMILTON, CAL.—The Northern California Power Company has commenced work on the construction of its transmission line from Hamilton to Princeton.

HANFORD, CAL.—Preparations are being made by the Hanford & Summit Lake Railway Company to extend its railway from Hardwick to Jamison, a distance of 26 miles. Work on extension will begin in about thirty days.

HANFORD, CAL.—The farmers living along the county road between Hanford and Guernsey are considering the question of securing electrical service from the San Joaquin Light & Power Company. As yet no definite action has been taken.

JACKSON, CAL.—Notice of appropriation of 20,000 in. of water from Mokelumne River has been filed by Leopold D. Caminetti. The water is to be diverted to Rock Canyon, 5 miles west of Jackson, and will be utilized to generate electricity.

LAKEPORT, CAL.—Application has been made by J. A. Foster and J. L. Davis to the Board of Trustees for a franchise to erect transmission lines for the distribution of electricity for lamps and motors in Lakeport.

LIVE OAK, CAL.—The proposition to form a lighting district in the town of Live Oak will soon be submitted to a vote. D. D. Green is town clerk.

LODI, CAL.—Arrangements are being made by the California Traction Company to begin work immediately on the construction of an extension of its railway from Lodi to Woodbridge.

OAKLAND, CAL.—Plans have practically been completed by the Oakland Gas Light & Heat Company for extensive improvements to its electric lighting system, which will involve an expenditure of $500,000. A contract has been awarded for the installation of a 15,000-kw turbo-generating unit. The boiler capacity will be increased by 10,000 hp. Cables and electric wires will be placed underground in the central portion of the city. Frank A. Leach, Jr., is manager.

PASADENA, CAL.—The Pacific Electric Railway Company will double-track its California Street line the entire length, work on which will begin at once.

PASADENA, CAL.—The City Council has awarded the contract for the installation of the underground conduit system for electric light and telephone wires on South Orange Grove Avenue to S. M. Kerns, of Los Angeles, Cal., for $33,700.

PORTOLA, CAL.—A temporary electric generating plant operated by steam power will be installed in the Portola Lumber Company's mill to furnish electricity for lamps and motors in Portola. The company owns water rights on Grizzly Creek, 2 miles above Portola, where, it is understood, it will develop and erect a permanent plant. Not a post office.

REDWOOD CITY, CAL.—The Southern Pacific Company has applied to the Board of Trustees of Redwood City for a fifty-year franchise to build a double-track electric railway through Redwood City, with extensions to the Woodside district.

SAN FRANCISCO, CAL.—The Board of Supervisors has passed a bill authorizing the Board of Public Works to construct shop buildings for the Polytechnic High School and for heating, ventilating, plumbing, gas-fitting and electrical work for the school, the cost not to exceed $103,000.

SNELLING, CAL.—Negotiations have been closed whereby the Merced River Land Company has purchased 2600 acres of land located one mile west of Snelling, including Grubb ranch. The company will install an electric pumping plant on the Grubb ranch in the near future. The headquarters of the company are located in Los Angeles. W. O. Huse is manager.

SONORA, CAL.—The Tuolumne River Power Company is reported to have transferred its holdings in Tuolumne County, consisting of a large tract of timber land, 65 miles water ditch, water rights, power sites and irrigation rights on the Tuolumne River, to the Yosemite Power Company, for approximately $650,000. The sale marks the beginning of a large power plant with an ultimate development of 75,000 hp, involving an investment of about $10,000,000. John Hays Hammond is said to be interested in the project.

GUNNISON, COL.—At an election held recently the proposition to issue $90,000 in bonds for the installation of an electric light plant and water-works system is reported to have been carried.

BRIDGEPORT, CONN.—It is reported that G. C. Batcheller & Company, of Bridgeport, Conn., are contemplating the erection of a building for a power plant.

BRIDGEPORT, CONN.—The New York, New Haven & Hartford Railroad Company, it is reported, is contemplating discarding the Seaview Avenue power house of the Connecticut Company in Bridgeport, and will erect a substation, for which electricity will be supplied from the power station at Cos Cob to operate the local street railway system.

BROOKLYN, CONN.—The People's Light & Power Company, of Danielson, Conn., has submitted a proposition to the village of Brooklyn offering to extend its transmission lines to Brooklyn, provided a sufficient number of contracts for electrical service can be secured.

JACKSONVILLE, FLA.—Bids will be received by W. W. Bostwick, Jr., chairman Trustees for Water Works and Improvement Bonds, until May 4, for building superstructure, including brick work, mill work, plumbing, heating, etc., for municipal power station, plans and specifications for which are on file in the office of the board, Jacksonville, Fla., and of the consulting engineers. Copies of plans and specifications may be obtained on application to the Scofield Engineering Company, of Philadelphia, Pa., consulting engineer. A deposit of $25 will be required for same.

ST. PETERSBURG, FLA.—J. J. Farnsworth, of Ft. Lauderdale, Fla., is reported to be interested in a project to construct an electric light plant from St. Petersburg to John's Pass, 7 miles in length.

SOUTH JACKSONVILLE, FLA.—At an election held recently the citizens voted to issue bonds to the amount of $60,000, the proceeds to be used for the installation of an electric-light plant and water-works system. Work will begin on construction of the plants as soon as the bonds are sold.

OGLETHORPE, GA.—At an election held April 12 the citizens voted in favor of the proposition to issue $18,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system. It is understood that bids for construction of the plants will be received about July 1. J. P. Nelson is mayor.

SWAINSBORO, GA.—At an election held recently the citizens voted to issue bonds to the amount of $40,000, the proceeds to be used for the construction of an electric light plant and water-works system.

GRANGEVILLE, IDAHO.—Plans are being considered by the Grangeville Electric Light & Power Company for the extension of its transmission lines from Cottonwood to Vollmer and Ilo, work on which will begin at once.

KAMIAH, IDAHO.—The Nez Perce Water & Power Company, of Nez Perce, is reported to have been granted a franchise by the Council to supply electricity for lamps in Kamiah. Z. A. Johnson, of Nez Perce, Idaho, is president of the company.

MINIDOKA, IDAHO.—The contract for furnishing equipment for the Minidoka irrigation project, including one 360-hp motor, two 600-hp motors and necessary switchboards to control motors and control panel for two 500-kw transformers, has been awarded to the Westinghouse Electric & Manufacturing Company, for $14,000.

CAIRO, ILL.—Plans are being considered for the installation of an ornamental street lighting system on Eighth Street, between Washington and Commercial Avenues.

COAL CITY, ILL.—Preparations are being made by the Illinois Valley Light & Power Company for the erection of an electric transmission line from the valley to the E. C. Haeger Brick and Tile Works.

LA SALLE, ILL.—Preparations are being made by the Chicago, Ottawa & Peoria Railway Company for the construction of three substations, contracts for which will be awarded in the near future, one to be located at Morris, one at Minooka and one at Joliet. Each building will cost approximately $5,000.

MT. CARMEL, ILL.—The City Council has granted the Mt. Carmel & Olney Interurban Railway Company a franchise to lay its tracks in this city, work on which, it is reported, will begin at once.

RUSHVILLE, ILL.—It is reported that plans are being considered to take over the railroad extending from Littleton to Macomb and equip it for electrical operation, extending it through Rushville or Mt. Sterling to Beardstown. H. C. Billingsley, of Chicago, Ill., is said to be interested in the project.

YORKVILLE, ILL.—Bids will be received until May 10 at the office of F. W. Simpson, secretary, Yorkville, Ill., for the construction of a hydroelectric plant, including the building of a dam across Fox River at Millhurst, Ill., construction of power house with wheel pits and tail-races complete for four 210-hp turbines; four 175-kw generators with switchboards and instruments complete. Plans and specifications can be seen at the office of F. W. Simpson, Yorkville, Ill., and at the office of H. D. Hallett, engineer, Aurora, Ill.

BLOOMINGTON, IND.—Surveys are now being made for the construction of an electric railway to connect Bedford, Oolitic, Harrodsburg, Smithville, Sanders, Clear Creek and Bloomington. Application for franchises for the proposed railway will soon be made.

HOBART, IND.—It is reported that the Gary, Hobart & Eastern Traction Company is planning to construct an electric railway from Hobart to Gary, Ind., a distance of about 5 miles. It is understood that contract for building the railway will be awarded about the middle of May. U. P. Hord, of Aurora, is president.

KENDALLVILLE, IND.—It is reported that plans are being considered to install an ornamental street lighting system in Kendallville.

ZIONSVILLE, IND.—The Zionsville Water & Light Company is contemplating the installation of either oil engines or a producer gas plant to take the place of its present steam plant. W. H. Palmer is manager.

BONAPARTE, IA.—The Council is reported to have granted a franchise for the installation of an electric light plant in Bonaparte. Electricity for operating the system will be supplied from the power plant of the United Woolen Mill.

CEDAR RAPIDS, IA.—The Cedar Rapids & Iowa City Railway & Light Company is contemplating the purchase of a 3000-kw or 2000-kw turbine and an 800-kw generator to be direct-connected to a compound engine. The purchase of a 500-kw, 60-cycle, two-phase rotary converter is also under consideration.

JEWELL, IA.—The Ames Engineering Company, of Ames, Ia., is reported to have been awarded the contract to install an electric light and power plant in Jewell, at a cost of $12,000.

MARENGO, IA.—The contract for installing an electric-light plant at the poor farm has been awarded to the Ames Engineering Company, of Ames, Ia., to cost $2,000.

NEWMARKET, IA.—The proposition to grant the Lee Electric Light Company, of Clarinda, Ia., a franchise to install an electric light plant in Newmarket will be submitted to a vote at an election to be held May 1.

EMPORIA, KAN.—The City Council is contemplating changing the motive power at the pumping station from steam power to electricity. The equipment will include two 3,000-000-gal. pumps and booster pump and about 3½ miles of transmission line. Bids for the above will probably be called for early in May. Fred. H. Smith is city clerk and Matthew Brown city engineer.

EMPORIA, KAN.—The citizens are reported to have voted at a recent election to grant a franchise to a Dayton syndicate which operates electric light and street railway systems in Lawrence and Parsons, Kan. The franchise includes the leasing of the municipal electric light plant. Albert Emanuel, Conover Building, Dayton, Ohio, is president of the Parsons Railway & Light Company, of Parsons, Kan., and the Lawrence Railway & Light Company, of Lawrence, Kan.

LA CYGNE, KAN.—It is reported that the proposition to issue $30,000 in bonds for the installation of an electric light plant and water-works system was carried at an election held recently. It is understood that new plants are to be installed. The J. S. Worley Company, of Kansas City, Mo., has charge of the engineering work.

WATERVILLE, KAN.—It is reported that bonds to the amount of $30,000 have been voted, the proceeds to be used for the installation of an electric light plant and water-works system.

RICHMOND, KY.—The power plant of the Richmond Electric & Power Company is reported to have been destroyed by an explosion, entailing a loss of about $10,000. It is understood that the plant will be rebuilt at once.

ELTON, LA.—The Elton Telephone Company, recently organized, with a capital stock of $5,000, proposes to erect telephone lines to furnish telephone service in Elton and surrounding country. W. H. Tupper, George Kinzer, F. E. Powell and others are interested in the company.

SHREVEPORT, LA.—The City Council has appropriated $1,000 to employ an engineer to make investigations and prepare plans and estimates of cost for a municipal electric light plant in Shreveport.

ROCKLAND, MAINE.—The Rockland, South Thomaston & St. George Railway Company is planning to build approximately 3½ miles of new track and may possibly erect a small power station during the summer. Alfred S. Black is president.

SYKESVILLE, MD.—Bids will be received at the office of the Governor of Maryland, Union Trust Building, Baltimore, Md., until May 8 for the construction of a power house and a building known as cottage "E" at the Springfield State Asylum, Sykesville, Md. Copies of plans and specifications can be secured at the office of Parker, Thomas & Rice, architects, Union Trust Building, Baltimore. Md., for which a deposit of $5 will be required, which will be refunded on return of plans.

BOSTON, MASS.—Sealed proposals will be received by the trustees of the Boston City Hospital, Boston, Mass., until May 2 for furnishing generator, switchboard and electric wiring at the Boston City Hospital. Specifications and blank form of proposal may be obtained at the office of Densmore & LeClear, engineers, 88 Broad Street, Boston, Mass. Separate proposals will also be received for a steam engine at the same place and date, and also for power house and pipe tunnels. John H. McCollom is superintendent.

BROCKTON, MASS.—The Edison Electric Illuminating Company of Brockton is contemplating extending its transmission lines through Hanson to Bryantville to supply electricity for lamps.

HUDSON, MASS.—Arrangements are being made by George A. Brothers, superintendent of the municipal electric light and power plant, for extending the transmission lines of the municipal electric light plant from Gleasondale to Stow lower village, the cost of which is estimated at about $5,000. The system was extended to Gleasondale, which is a part of Stow, five years ago.

LEE, MASS.—The Smith Paper Company, of Lee, Mass., is contemplating equipping its five mills for electrical operation. It is understood that the change will not be made at present.

MANSFIELD, MASS.—The South Eastern Massachusetts Electric Company, recently incorporated with a capital stock of $150,000, proposes to purchase and develop existing plants now operating in the counties of Norfolk, Bristol and Plymouth. Philip Cabot, Charles S. Davis, of Boston, Mass., and Frank H. Coyne, of Foxboro, Mass., are interested in the company.

DETROIT, MICH.—A new factory is being erected by the Douglas & Lomason Company, of Detroit, Mich. The machinery in the plant will be equipped for electric motor drive throughout, electricity for which will be supplied by the company's own plant.

DETROIT, MICH.—The Piedmont Graphite Company, which is now located in Atlanta, Ga., is reported to be planning to move its plant to Detroit. The company has purchased a site on Jefferson Avenue, on which it will erect a large plant. It is said that the electric process will be used for graphite refining.

KALAMAZOO, MICH.—A deed of transfer has been recorded in the registrars' offices at Kalamazoo, Marshall, Allegan and Jackson, Mich., conveying all the property of the Jackson Light & Power Company to the Commonwealth Power Company.

PENTWATER, MICH.—Plans are being made to construct an electric railway from Pentwater to Walkerville via Crystal Valley, 20 miles in length. The capitalists who propose to build the road demand a bonus of $50,000 from the towns along the route of the proposed railway.

DULUTH, MINN.—The City Council has passed a resolution authorizing the city engineer to prepare estimates of the cost of construction of a municipal electric light, heat and power plant, to give substantially the same service as now furnished by the Duluth-Edison Electric Company. An appropriation of $2,500 was made to secure the assistance of an electrical engineer.

EVELETH, MINN.—The contract for erecting ornamental lamp standards, complete, for the new lighting system on Grant Avenue has been awarded to John S. Swanson, of Duluth, Minn., for $4,796. The plans call for forty-six lamp standards, each carrying five lamps.

MINNEAPOLIS, MINN.—The Minneapolis, St. Paul & Dubuque Railway Company is planning to extend its railway from Northfield to Owatonna, Minn., a distance of 32 miles. It is expected to have it in operation by September 1.

NASHWAUK, MINN.—Bids will be received until May 1 for furnishing direct-current meters (new and second-hand). John H. Carlson is village clerk.

REDWOOD FALLS, MINN.—The Wherland Electric Company is reported to be contemplating extending its transmission lines to Franklin, Minn.

ST. PAUL, MINN.—The State Legislature has passed the bill permitting the organization of a company to distribute the power generated at the large dam to be constructed in the Mississippi River, near Minnehaha Creek. Under the present plans the United States government reserves a certain amount for use at Fort Snelling, after this a certain amount is allotted to the State institutions and the remainder is to be controlled by the proposed corporation. The organization will be composed of representatives of the Twin City and those of the University of Minnesota. The municipality and the university will receive electrical energy at cost and the balance sold at a profit.

BISMARCK, MO.—Plans are being considered for the construction of an electric interurban railway to connect Bismarck and Sunlight, 20 miles in length. The proposed railway will be known as the Bismarck, Belleview Valley & Western Railway.

CHILLICOTHE, MO.—Sealed proposals will be received until May 8 by Ira G. Graham, city auditor, at the office of the City Clerk, Chillicothe, Mo., for furnishing material and construction of a complete municipal electric light and power plant as follows: Section 1—Concrete work, floor machinery and building foundations. 2—Brick power house complete, excluding foundations and floor. 3—Radial brick or concrete chimney. 4—Steam boiler and equipment. 5—Boiler feed pumps, heater, separators, traps and all pipe work. 6—Two steam engines, 7—Two generators, 125-kva and 250-kva, and exciters, switchboards and regulators. 8—Pole line, transformers and street lighting system. 9—1000-ft. deep well for water supply. 10—Steel tower and tank, having a capacity of 5000 gallons. Plans and specifications are on file in the office of the city clerk, Chillicothe, Mo., and at the office of Fuller-Coult & Company, engineers, Chemical Building, St. Louis, Mo. Bids may be submitted on the whole or on any section or combinations of sections thereof. Extra copies of plans and specifications may be obtained from the engineers on payment of $5 to cover the cost of printing.

KANSAS CITY, MO.—Surveys have been completed by the West Missouri Electric Railway Company for its proposed electric railway from Kansas City to Grandview, Belton and Harrisonville, Mo., 34 miles in length. It is understood the contract for building the road has been awarded to the Spitcaufsky-Wagner Contracting Company, of Kansas City, Mo. H. A. Nagle, of Kansas City, Mo., is chief engineer.

ST. LOUIS, MO.—The Public Service Commission has signed the bill regulating the rates to be charged for electricity in St. Louis, Mo., to take effect Oct. 22, 1911. Under the new law the maximum rate for electricity is reduced from 12 cents to 9½ cents per kw-hour and the minimum charge from $1 per month to 50 cents per month.

HELENA, MONT.—Bids will be received at the office of the State Board of Examiners, Helena, Mont., until June 17 for furnishing electrical fixtures for the Capitol Building additions, etc., in accordance with specifications, which may be seen at the office of the State Board of Examiners, or at the office of Link & Haire, architects, Helena, Mont. A. N. Yoder is secretary of the board.

CHAPPELL, NEB.—It is reported that bids opened by the village of Chappell, April 8, for the construction of an electric light plant and waterworks system were rejected. New bids will be received until May 8. The cost of the work is estimated at $12,900. W. E. Donner, of Grand Island, Neb., is engineer.

OMAHA, NEB.—The Nebraska Transportation Company has awarded the contract for the construction of an interurban railway to extend from Omaha through Arlington, Bertha and Salthill to Sioux City, with branches from Elk City to Madison and Norfolk, and from Bertha east to Decatur and west to West Point, to the Baker Construction Company, of Omaha, Neb. The entire system will include about 284 miles of track. The power house will be located on the Platte River, near Elk City, and will have an output of about 21,000 hp. The railway complete will cost about $8,000,000 and will be completed in about two and a half years.

ELIZABETH, N. J.—The installation of an ornamental lighting system on Broad Street, Elizabeth, is under consideration. Albert C. Stein is interested in the project.

SOCORRO, N. M.—The property of the Socorro Electric Light & Power Company was sold at auction April 1 to the bondholders, C. T. Brown, Joseph Price, James G. Fitch and E. A. Drake, for $17,700. The plant is in operation and giving good service.

AUBURN, N. Y.—The Auburn Light, Heat & Power Company has been awarded an extension of its street-lighting contract in Auburn for a period of five years, and was also given a ten-year contract for furnishing ornamental lamps in the business section of the city.

AUBURN, N. Y.—It is reported that negotiations are under way for the consolidation of the gas and electric light companies of Auburn, Geneva, Seneca Falls and Waterloo. E. H. Palmer, of Geneva, N. Y., president of the Auburn Gas Company, it is said, will head the new enterprise. The new company will be known as the Empire Gas & Electric Company.

CATSKILL, N. Y.—The Catskill Traction Company will soon begin work on making surveys and securing right of way for the construction of two extensions to its railway system, one to extend from Catskill to Alsen and Cementon and the other from Leeds to Cairo.

EPHRATAH, N. Y.—The Mohawk Hydroelectric Company has received authority from the Public Service Commission, Second District, to construct and operate transmission lines to supply electricity in the town of Ephratah. The company has been granted permission to issue bonds to the amount of $53495, the proceeds to be used for carrying out the work.

JAMESTOWN, N. Y.—The Jamestown Street Railway Company has commenced work on an addition to its central power station on West Eightieth Street.

LOCKPORT, N. Y—The Upson Company, of Lockport, N. Y., it is said, will enlarge the old Franklin Mills in East Lockport, instead of building a new plant. Both electric and water-power will be used, and it is understood that the company will be in the market for small electric units, overhead trolley conveyors, shafting, etc. Charles A. Upson, of Lockport, N. Y., is president of the company.

MARION, N. Y.—The Public Service Commission, Second District, has authorized the Marion Power Company to construct and operate an electric light plant in Marion and to erect a transmission line along the highway between the towns of Marion and Williamson. The company will secure Niagara power through the Rochester Railway & Light Company. Application has been made by the Marion Power Company to the commission for permission to issue $8,000 in capital stock and to execute a mortgage for $10,000, the proceeds to be used to pay for construction of its new plant.

NEW YORK, N. Y.—Kopp Brothers, Irving Place and Sixteenth Street, New York, N. Y., are reported to be contemplating the installation of two 150-kw generating units. O. E. Goldsmith, 30 West Thirty-eighth Street, New York, N. Y., is consulting engineer.

POUGHKEEPSIE, N. Y.—The Public Service Commission, Second District, has authorized the Poughkeepsie Light, Heat & Power Company, of Poughkeepsie, the Newburgh Light, Heat & Power Company, of Newburgh, and the Hudson Counties Gas and Electric Company, of Cornwall-on-Hudson, to consolidate under the name of the Central Hudson Gas & Electric Company.

ROCHESTER, N. Y.—Bids will be received at the office of the secretary of the Board of Contract and Supply, Room 37, City Hall, Rochester, N. Y., until May 3 for the electric lighting and power wiring of buildings 2, 3 and 4; also erection of boiler house at Exposition Grounds. Specifications are on file at the office of Gordon & Madden, architects, Sibley Block, Main Street, Rochester.

SMITHTOWN, N. Y.—The Long Island Lighting Company has applied to the Town Board for a franchise to erect and operate transmission lines for the distribution of electricity in Smithtown. It is understood that the Long Island Lighting Company has acquired an option on the controlling interest of the North Shore Electric Light & Power Company, of Port Jefferson, and it is proposed to consolidate the plants in Port Jefferson, Northport, Amityville, Islip and Sayville. Improvements and extensions, involving an expenditure of about $350,000, are under consideration.

SYRACUSE, N. Y.—Plans are being prepared by the city of Syracuse for the construction of a vocational high school, including a power plant machine shop, foundry and woodworking shop. Henry C. Allen, city engineer, has charge of the plans.

DURHAM, N. C.—The Southern Power Company has purchased a site in Durham, on which it proposes to erect a distributing station, which will provide for 20,000 hp. The company is now extending its high-tension transmission lines to Durham.

GREENSBORO, N. C.—Cesar Cone, president of the Proximity Manufacturing Company and the White Oak Cotton Mills, has made arrangements with the Southern Power Company, of Charlotte, N. C., for furnishing secondary power for the mills, which will be delivered at the White Oak power station. Preparations are now being made to install the necessary apparatus for this change, which will involve an expenditure of several thousand dollars.

GREENVILLE, N. C.—Arrangements are being made by the American Spinning Company to change the motive power of its No. 1 mill from steam to electricity, which will require the installation of a 600-hp motor, contract for which has been awarded. Electricity for operating the mill will be secured from the Greenville transmission line of the Southern Power Company.

LINWOOD, N. C.—The Fairmont-Silver Telephone Company, recently incorporated by G. C. Palmer, of Silver Hill, N. C., and others with a capital stock of $20,000, proposes to erect a telephone line from Southmount and Silver Hill to Lexington Post office address, Linwood, R. F. D., No. 2.

RALEIGH, N. C.—The Carolina Power & Light Company has filed an amendment to its charter increasing its capital stock from $3,750,000 to $7,500,000. Charles E. Johnson, of Raleigh, is president of the company.

MILTON, N. D.—The installation of an electric light plant in Milton is reported to be under consideration. C. Holley is said to be interested in the project.

VELVA, N. D.—The Council is reported to have granted John I. Moore a franchise to install and operate an electric light system in Velva.

AKRON, OHIO.—Plans and specifications are being prepared by H. von Schon, consulting engineer, Detroit, Mich., for the Northern Ohio Traction & Light Company for its water-power development on the Cuyahoga River.

AMANDA, OHIO.—The Crystal Paper Company is reported to have awarded contracts for the erection of a paper mill and power house, 50 ft. x 500 ft.

CINCINNATI, OHIO.—The Cincinnati Short Belt Railroad & Traction Company is contemplating the construction of an electric railway through Duck Creek Valley, Madisonville, Oakley, Norwood, Bond Hill and the Mill Creek Valley, from Red Bank to Chester Park. It is planned later on to extend the railway to the Ohio River line and to connect all railroads in the Cincinnati zone to facilitate switching traffic. Peter Eichels, of Cincinnati, Ohio, is interested in the project.

CINCINNATI, OHIO.—The Alvey-Ferguson Company, of Louisville, Ky., is reported to be contemplating the erection of a large manufacturing plant in Oakley, a suburb of Cincinnati, where it has purchased a site. It has not yet been stated whether the company will install its own power plant or purchase energy for lamps and motors from a large central-power plant in Oakley. The company manufactures conveying machinery.

COLUMBUS, OHIO.—It is reported that an Eastern syndicate, represented by J. J. Henry, which is contemplating the construction of a large power plant in the Hocking Valley, near Beaumont, has secured options on the electric light and power plants at Nelsonville, Logan, Lancaster and other towns in the Hocking Valley. It is understood that the company proposes to supply electricity to the above towns from the proposed plant.

LOGAN, OHIO.—The village of Logan is reported to be preparing plans for the construction of an electric power plant.

TOLEDO, OHIO.—Sealed proposals will be received at the office of the clerk of the Board of Education of the city school district of the city of Toledo until May 15 for furnishing material and installing an electric light and power system, interior telephone system, an electric time clock and program bell system, in either or both school buildings now in course of construction, known as the Morrison R. Waite High School and the Jessup W. Scott High School, according to plans and specifications which can be seen at the office of the department of architecture of the Board of Education. Copies of plans and specifications can be secured on application to the director of schools. A deposit of $25 will be required for each set furnished, of which $20 will be refunded upon return of the plans. George L. McKesson is director of schools.

BARTLESVILLE, OKLA.—Contracts will be placed by the Bartlesville Interurban Railway Companyy for the construction of a new boiler-room

at its power plant in Bartlesville. The company is also contemplating the purchase of a 500-kw turbine set, one 400-hp water tube boiler and 50-kw transformers.

GUTHRIE, OKLA.—It is reported that the Oklahoma Railway Company is planning extensions to its local systems in Oklahoma City and Guthrie, Okla., and for construction of interurban lines. The interurban railway, which now runs from Oklahoma City to within six miles of Edmund is to be extended to Guthrie. It is said that the company has negotiated for a sale of bonds to the amount of $12,000,000. John W. Shartel, of Oklahoma City, Okla., is vice-president.

TULSA, OKLA.—The Tulsa-Sand Springs Interurban Railway Company is reported to be contemplating extending its railway to Collinsville and from there it may be extended to Oologah, where a connection will be made with the Iron Mountain Railroad. Charles Page is said to be interested in the company.

BAKER CITY, ORE.—At an election held April 12 the citizens voted to issue $25,000 in bonds for the construction of a hydroelectric light plant. J. W. Bailey, of Baker City, Ore., city engineer, has charge of the work.

BAKER CITY, ORE.—It is reported that the Western Granite Company, of Baker City, Ore., is contemplating the installation of an electric generating unit at its quarry.

CULVER, ORE.—The Cove Power Company has begun work on construction of a power plant on the Crooked River, 2 miles west of Culver. A contract for a large part of the work has been awarded to Brown & Van Valkenburg, of Culver, Ore.

WALLOWA, ORE.—Plans are being made by the McCully-Rumble Power Company, recently organized, to erect a power plant on the Wallowa River, about 20 miles from this city. The company proposes to generate about 1000 hp and supply electricity to all towns and rural communities in Wallowa and Union Counties and to the farming district between Joseph and La Grande. F. D. McCully, of Joseph, and E. W. Rumble, of La Grande, are interested in the company.

ALTOONA, PA.—The Penn Central Light & Power Company is planning to make improvements and extensions to the Warrior Ridge plant, including the installation of a 2500-kw turbo-generator set, with necessary boilers and other equipment. A number of changes will also be made to the local plant.

HARRISBURG, PA.—The contract for the installation of electrical fixtures in the Technical High School has been awarded to Lloyd, Garrett & Company, of Philadelphia, Pa., for $3,500.

HELLERTOWN, PA.—The Hellertown & Richlandtown Street Railway Company, recently organized with a capital stock of $360,000, proposes to construct an electric railway from Hellertown to Richlandtown, a distance of about 6 miles. The proposed railway will provide both passenger and freight service. The officers of the company are: A. R. Trumbauer, president; Jacob Apple, secretary, and W. B. Frankenfield, treasurer.

PARKER, PA.—It is stated that applications are to be made to the State Department for charters of incorporation for water power privileges on the Clarion River in Clarion County. Nine separate charters are to be asked for in as many townships. It is proposed to erect a large dam on the Clarion River at Clarion, with power plant to cost approximately $3,000,000. Joseph R. Paull, H. W. Douglass and J. P. Fife, of Pittsburgh, Pa., are interested in the project

PHILADELPHIA, PA.—The Philadelphia Electric Company has purchased a site on West Thirtieth Street, on which, it is said, it will erect an auxiliary power plant.

PHILADELPHIA, PA.—Plans are being considered by Chief McLaughlin, of the Electrical Bureau, for lighting the Southern Boulevard with electricity. The present plan provides for the installation of 190 arc lamps of 2000 cp, arranged in pairs to be erected on ornamental standards, similar to those on Market and other streets in the center of the city, and 420 tungsten lamps of about 70 cp each on the side of the service driveways flanking the boulevard. The latter lamps will be erected on 10-ft. poles, one lamp to each standard, inclosed in a 16-in. globe. For the erection of the arc lamps and standards, with the necessary wires and conduits, there is about $75,000 available.

STEELTON, PA.—Plans are being considered by the Steelton Light, Heat & Power Company for the construction of an auxiliary plant for use in case of emergency. The proposed plant will have an output of about 400 hp. Energy for operating the local system is secured from the hydroelectric plant of the York Haven Water & Power Company at York Haven. The company also contemplates the erection and equipment of a new substation in Steelton.

TITUSVILLE, PA.—The capital stock of the Titusville Light, Heat & Power Company has been increased from $5000 to $150,000.

CHESTERFIELD, S. C.—The Chesterfield Light & Power Company will receive bids at once for the construction and equipment of an electric light plant. Proposals should be addressed to W. D. Craig, Chesterfield, S. C. The company was recently incorporated with a capital stock of $5,000 by W. D. Craig, D. P. Douglas and J. H. Welsh.

JACKSON, TENN.—Contracts have been awarded for equipment for the municipal electric light plant as follows: To the General Electric Company, of Schenectady, N. Y., for generator, arc lamps, etc., and for engine to the Hooven, Owens, Rentschler Company, of Hamilton, Ohio, the total cost aggregating $14,750. T. H. Hartmus is secretary of the Water Works Department.

MANCHESTER, TENN.—Bonds to the amount of $25,000 have been voted for the installation of a municipal electric light plant and waterworks system in Manchester.

ALICE, TEX.—T. M. Stevens has secured a franchise to supply electricity for lamps and motors in Alice. A 10-ton ice plant will be installed in connection with the electric plant.

BROWNSVILLE, TEX.—The City Council has refused the application of the Brownsville & Gulf Railway Company for a franchise to rebuild its track through the center of the town and to operate a motor car line between Brownsville and Matamoras, Mex. The City Council recently declared the track to be a public nuisance.

COLEMAN, TEX.—The contract for the construction of the new electric light plant in Coleman has been awarded to the Briggs-Weaver Machinery Company, of Dallas, Tex.

COLORADO, TEX.—The Southwestern Telegraph & Telephone Company has purchased the plants and holdings of the Texas & Pacific Telephone Company, including local exchanges at Merkel, Roscoe, Sweetwater, Colorado and Westbrook, and toll lines from Abilene to Big Springs.

DALLAS, TEX.—Plans are being prepared by the East Texas Traction Company for the construction of an interurban electric railway between Dallas and Terrell, a distance of about 30 miles. C. L. Wakefield is interested in the project.

DEL RIO, TEX.—Preliminary surveys are now being made for a large hydroelectric plant and irrigation project to be established on the Pecos and Devil's Rivers in the Del Rio section by a syndicate in which ex-Governor David R. Francis, of St. Louis, Mo., is interested. The cost of the enterprise is estimated at about $5,000,000.

FORT STOCKTON, TEX.—It is reported that local capitalists are organizing a company to construct and operate an electric light and ice plant in Fort Stockton.

GALVESTON, TEX.—The federal government, through Major C. P. Howell, United States engineer in charge of the Galveston district, has awarded the contract for laying telephone, electric light and power cables and an 8-in. water main on the dike from a point opposite Fourteenth Street to the site of the government immigrant station, to C. K. Spalding and Thad Parsons.

LLANO, TEX.—We are informed that the city is not contemplating improvements to the municipal electric light plant, as reported in the issue of April 20. Electrical service in Llano is supplied by the Llano Milling & Manufacturing Company.

PALESTINE, TEX.—Ralph E. Hoskat, of Dayton, Ohio, and associates have submitted a proposition to the citizens of Palestine offering to construct and operate an electric street railway system in Palestine, provided a bonus of $30,000 is given to the company.

MORRISVILLE, VT.—The citizens have voted to authorize the superintendent and commissioners of the municipal electric light plant to enter into a contract with the village of Stow to supply electricity for lamps in the latter place for a term of ten years.

NORFOLK, VA.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 27 for furnishing and installing dry-dock pumping equipment, including two motor-driven dry dock pumps, one motor-driven drainage pump, and one motor-driven bilge pump, all complete with necessary piping and accessories, at the navy yard, Norfolk, Va. Plans and specifications can be obtained on application to the bureau or to the commandant of the navy yard named. R. C. Holliday is chief of bureau.

CASTLEROCK, WASH.—It is reported that Collins & Byerly will erect a hydroelectric plant on the Toutle River, about 8 miles from Castlerock, work on which has begun. About 1000 hp will be developed.

ELLENBURG, WASH.—Application has been made to the County Commissioners by Paul Richards for a franchise to construct and operate an electric motor railway system on the highways in Kittitas County.

NORTH YAKIMA, WASH.—Plans are being prepared by H. E. Doolittle, city engineer, for the proposed municipal electric light and power plant, to cost approximately $250,000.

VANCOUVER, WASH.—A site has been purchased by the Mount Hood Railway & Power Company on Fifth Street Road, near the Garrison in Vancouver, on which it will build a substation. The cost of the substation and distributing system in Vancouver will involve an expenditure of $25,000.

WALLA WALLA, WASH.—Preparations are being made by the Pacific Power & Light Company for the erection of a transmission line from Walla Walla to Dayton, via Dixie, Prescott and Waitsburg, work on which will begin in the near future. The cost of the line is estimated at about $50,000. The power plants at Waitsburg and Dayton will soon be taken over by the Pacific Power & Light Company.

ELLENBORO, W. VA.—The American Under Current Company, recently organized, to manufacture apparatus for a new system of electric traction, is planning to erect a factory about one mile from Ellenboro. In connection with the plant the company will build a demonstrating track, which may eventually connect the towns of St. Marys and Pennsboro. It is understood that a power plant will also be installed.

MORGANTOWN, W. VA.—The Union Utilities Company, of Morgantown, W. Va., is contemplating the purchase of three gas compressors and three 3-phase, 60-cycle, 2200-volt motors for its power plant in Morgantown.

ALTOONA, WIS.—At an election held ecently the citizens voted to grant the Chippewa Valley Railway, Light & Power Company, of Eau Claire, Wis., a franchise to supply electricity for lamps and motors in Altoona.

MENASHA, WIS.—The City Council is contemplating enlarging the municipal power plant and installing two Deisel engines of 225 hp, the cost of which is estimated at $30,000.

MANITOWOC, WIS.—Plans have been completed by the Aluminum Goods Manufacturing Company for the construction of a factory building, 300 ft. x 400 ft., and a power house and service tower. The power house will be equipped with a direct-connected electric generating unit, with a rating of about 300 hp. All machinery will be motor-driven.

REVELSTOKE, B. C., CAN.—The by-law appropriating $50,000 to complete the municipal power plant has been approved by the ratepayers. The city, it is said, is contemplating supplying electricity to operate the shops of the Canadian Pacific Railroad Company.

VERNON, B. C.—The Couteau Power Company is planning to build an electric railway between Vernon and Lumby, 20 miles in length. The power plant will be located at Shuwap Falls. The company will furnish electricity for lighting.

FREDERICTON, N. B., CAN.—Application has been made to the New Brunswick Legislature for a charter for the Eel River Light, Heat & Power Company by H. A. Connell, George McPhail, of Woodstock, N. B.; John G. Murchie, George A. Murchie and George Andrews, of St. Stephen. The company will be capitalized at $300,000 and proposes to develop water-power on the Eel River and lakes thereon to generate electricity. It is estimated that 4000 hp can be developed under a head of 70 ft., which will be transmitted to Fredericton, Woodstock, St. Stephen, St. Andrew and McAdam.

QUEBEC, QUE., CAN.—It is reported that the Quebec Railway, Light & Power Company has been awarded the contract for lighting the South Shore, opposite the city of Quebec, for a period of ten years.

New Industrial Companies.

THE ACME HOISTING MACHINE COMPANY, of St. Louis, Mo., has been incorporated with a capital stock of $50,000 by F. R. McCune, George S. Cornell and John M. Patke. The company proposes to manufacture hoisting, illuminating, excavating and carrying machinery

THE AUTOMATIC SAFETY APPLIANCE COMPANY, of La Salle, Ill., has been chartered with a capital stock of $100,000 by A. G. Hulling, W. H. Traver and T. Baird, of La Salle, Ill. The company proposes to manufacture elevator appliances.

THE BOYSE CARMICHAEL MANUFACTURING COMPANY, of Chicago, Ill., has filed articles of incorporation with a capital stock of $100,000 for the purpose of manufacturing electrical and gas appliances. The incorporators are: D. B. Carmichael, C. W. Boyse and J. J. Elias, of Chicago, Ill.

THE BUTTE ELECTRIC SUPPLY COMPANY OF UTAH, of Butte, Mont., has been incorporated with a capital stock of $250,000 by E. E. Brazier and others. The main offices of the company will be located in Butte, Mont.

THE CALL SWITCH & FROG COMPANY, of Denver, Col., has been incorporated with a capital stock of $50,000 to manufacture the Call automatic railroad switch and other railroad supplies. The company will begin work at once on the erection of a factory in Denver, Col.

THE FEDERAL MINIATURE LAMP COMPANY, of Cleveland, Ohio, has been chartered with a capital stock of $30,000 by S. M. Lee, H. M. Vansvail, J. E. Kewley and W. G. McKittrick.

THE HOGAN MOTOR COMPANY, of New York, N. Y., has been chartered with a capital stock of $30,000 by John J. Hogan, of West Haven, Conn.; James R. Taylor, James V. Simpson, both of Mt Vernon, N. Y. The company proposes to manufacture machinery, engines, motors, etc

THE JEFFRIES ELECTRIC & MANUFACTURING COMPANY, of Cleveland, Ohio, has been chartered with a capital stock of $10,000 by S. S. Jeffries, H. W. Culbertson and others.

THE MILLS-ANTHONY COMPANY, of Toledo, Ohio, has been incorporated by Benjamin Mills, Daniel W Miller, J. V. Kieler, George E. Anthony and J. J. Waldvogel. The company is capitalized at $10,000 and proposes to deal in electrical specialties.

THE NEW YORK SERVICE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $50,000 by M. D. Ferris, A. Begg and J. W. Crandall, of New York, N. Y. The company propose to do a general contracting and mechanical engineering business and to manufacture machinery, etc.

THE RANDALL TELEPHONE COMPANY, of Augusta, Me., has been chartered with a capital stock of $1,500,000 to manufacture and deal in telephone instruments, etc. E. M. Leavitt, of Augusta, Me., is president and manager.

THE UNIVERSAL ELECTRIC MANUFACTURING COMPANY, of Bradford, Pa., has been incorporated with a capital stock of $1,000,000 by Elisha B. Cutler, Charles E. Foster, George W. Foster, Charles W. Randall and William H. Olsmtead, all of Bradford, Pa. The company proposes to manufacture and sell all kinds of electrical appliances and devices.

New Incorporations.

MONTGOMERY, ALA.—Articles of incorporation have been filed for the Lee Street Terminal Company with a capital stock of $80,000. The company proposes to construct and operate electric and steam railways in Montgomery. The officers are: W. J. Hannah, president; S. H. Roberts, vice-president; F. B. Powell, secretary, and J. W. Winchester, treasurer.

SAN FRANCISCO, CAL.—The West Coast Power Company has been incorporated with a capital stock of $500,000 by S. E. Bretherton, H. P. Anewalt, I. J. Broberg, M. F. Vandall and G. O. Perry.

MINONK, ILL.—Articles of incorporation have been filed for the Union Light & Power Company by F. Z. Ames, S. C. Kipp and J. S. Webber, of Minonk, Ill. The company is capitalized at $100,000 and proposes to operate a heat, light and power plant.

Personal.

MR. J. E. FRIES read a paper before the Cleveland branch of the American Institute of Electrical Engineers on Monday, April 17, on the subject "Power Factor."

MR. A. C. EINSTEIN, president and general manager of the King Electric Company, St. Louis, Mo., has been elected president of the Columbian Club of St. Louis

MR. NELSON G. PHELPS, formerly of the Peoria Gas & Electric Company, has been appointed new-business manager of the Hoopeston Gas & Electric Company, Hoopeston, Ill.

DR. C. P. STEINMETZ, of Schenectady, recently delivered a series of two lectures on "Electrical Energy" before the students of the College of Engineering of the University of Illinois.

MR. KEMPSTER B. MILLER, consulting engineer, Chicago, delivered a lecture on the topic "The Work of the Telephone Engineer" at the Throop Polytechnic Institute, Pasadena, Cal., on April 10.

MR H. VON SCHON has been retained as consulting engineer by the Northern Ohio Traction & Light Company in connection with the development of water-power on the Cuyahoga River near Akron, Ohio.

MR. THOMAS F. KELLY, contract agent of the Hamilton Electric Light & Power Company, Hamilton, Ont., has been appointed assistant master of transportation for Canada of the National Electric Light Association.

MR. C. A. HOWE, who has been appointed general manager of the Holophane Company, Ltd., of Toronto, Canada, has been located in Chicago for the past four years and is now vice-president of the Electric Club of Chicago.

MR. FRED. RIEBEL, formerly manager of the repair department for the Westinghouse Electric & Manufacturing Company at Pittsburgh, has been appointed superintendent of the Bedford Power Company's steam and water-power system at Bedford, Ind.

MR. M. A. MARCA ROMERO, formerly electrical and mechanical engineer of the Empresas Electricas Asociadas, Lima, Peru, has been selected by the government of Peru to visit the United States in the interest of the first school of aviation founded in South America.

MR. GEORGE N. REINHART, electrical engineer, Frankfort-on-the-Main, Prussia, who has been in this country for the past three months inspecting the various high-tension transmission systems, will depart for his home abroad the steamship *Cleveland* on April 27.

MR. H. M. SLAUSON has resigned as general sales manager of the Opalux Company, New York City, to take effect May 1, to accept a position as New Jersey representative of the H. W. Johns-Manville Company. Mr. Slauson's successor will be Mr. C. H. McCormack.

MR. H. F. PARSHALL, consulting electrical engineer, London, England, has been appointed chairman of the board of directors of the Central London Railway. Mr. Parshall was born in Milford, N. Y., forty-five years ago and is well known among engineers in this country.

MR. J. G. ROSSMAN, of New York, has been appointed business manager of the Winnipeg municipal hydroelectric plant, to assume duties on May 15. Mr. Rossman was born in the State of Georgia thirty-nine years ago, and is at present in the employ of Westinghouse, Church, Kerr & Co., New York City.

MR. WALTER R. ARMSTRONG, the newly appointed president and general manager of the Federal Miniature Lamp Company, has devoted much time during the past four years to developing a high-efficiency incandescent lamp for automobile head lanterns, having been associated in this work with a large number of storage-battery, generator and automobile manufacturing concerns. His experience in lamp manufacture dates back to 1886, and he has made special study of miniature and novel types of lamps for the past twenty years.

MR. JAMES CAMPBELL has been selected to succeed Mr. John I. Beggs as president of the Milwaukee Electric Railway & Light Company and the Milwaukee Light, Heat & Traction Company. In association with Mr. Campbell will be Mr. J. D. Mortimer, who will succeed Mr. Beggs as general manager of the companies. Mr. Campbell is president and Mr. Mortimer vice-president of the North American Company, which is interested in the following companies through ownership

of stock: The Detroit Edison Company, the Union Electric Light & Power Company, the United Railways Company, the St. Louis County Gas Company, the West Kentucky Coal Company and the two companies first mentioned above.

MR. WILLIAM McCLELLAN, of the Campion McClellan Company, has been appointed electric engineer to the Public Service Commission of the Second District of the State of New York. Mr. McClellan was actively engaged in the installation of the 11,000-volt single-phase railway equipment of the Erie Railroad, and has maintained steadily an especial interest in electric railway work. He is a member of the American Institute of Electrical Engineers and has served as chairman of its railway committee. He is a member of the New York Railroad Club and has served as a member of the committee on the electrification of steam railroads. Mr. McClellan is a graduate of the University of Pennsylvania, from which he received the degree of Doctor of Philosophy, and for which he served as instructor in engineering physics. He was for a time engineer in charge of construction with the Philadelphia Rapid Transit Company. In 1905 he came to New York City to become associated with Westinghouse, Church, Kerr & Company, under whose direction the single-phase equipment for the Erie Railroad was installed. Since 1907 Mr. McClellan has been vice-president of the Campion McClellan Company, New York and Philadelphia, engineer-constructors in industrial and public service work; a director in the Automatic Train Stop Company, and president of the McClellan Lines Company.

MR. BERNARD E. SUNNY, the recently elected president of the Michigan State Telephone Company and the Central Union Telephone Company, will also be elected president of the Wisconsin Telephone Company and the Cleveland Telephone Company, in pursuance of the policy of grouping the executive control of operating companies recently adopted by the parent Bell organization. Mr. Sunny is president of the Chicago Telephone Company, vice-president of the American Telephone & Telegraph Company, and a director of the General Electric Company, Western Electric Company, Chicago City Railway Company, First National Bank of Chicago and Public Securities Corporation of Chicago. He has filled several civic positions, and has taken an intelligent and progressive interest in politics. For three years he was president of the Civic Federation of Chicago, and the Armour Institute of Technology has conferred on him the honorary degree of doctor of engineering. Mr. Sunny began his career as a telegraph operator in Brooklyn, next engaging in the telephone business, becoming superintendent of the Chicago Telephone Company in 1879. In 1888 he was elected president of the old Chicago Arc Light & Power Company, which was merged into the present Commonwealth Edison Company a number of years ago. In 1891 he became Western manager of the Thomson-Houston Electric Company and afterward of its successor, the General Electric Company. This position he held until 1908, when he returned to the Chicago Telephone Company as its president. He is a member of the American Institute of Electrical Engineers and of many other societies and clubs. Mr. Sunny's career has been a remarkable one, as few men have been conspicuous both in the telephone and electric light and power industries and in the manufacturing and operating sides of the industries in each case.

B. E. SUNNY

MR. ANGUS S. HIBBARD, second vice-president and general manager of the Chicago Telephone Company, and for many years identified prominently with the telephone service of the city of Chicago, will remove to New York early in May, to take a position on the staff of Mr. Theodore N. Vail, president of the American Telephone & Telegraph Company. It is understood that Mr. Hibbard will engage in the work of co-ordinating the telephone and telegraph systems throughout the country, as proposed by Mr. Vail in his recent annual report. Mr. Hibbard has been prominent in the technical, commercial and social life of Chicago. He is a native of Milwaukee and received his early education at the Milwaukee Academy and the Racine College. For nearly all his business life he has been identified with the telegraph and the telephone. After service with the Wisconsin Telephone Company he was made general superintendent of the predecessor of the American Telephone & Telegraph Company in New York in 1886. He came to Chicago in 1893 as general manager of the Chicago Telephone Company, and has filled that position ever since, being promoted to the vice-presidency in addition. He was perhaps the first telephone manager to introduce the lamp-signal system in telephone switchboards on a large scale. He has invented and patented a number of useful devices for telephone work. He is a member of the American Institute of Electrical Engineers, of which he was manager from 1892 to 1895 and vice-president from 1895 to 1897. He is also a member of the Chicago Association of Commerce and of many clubs, including the University and Union League Clubs of Chicago. Mr. Hibbard is a musician of more than ordinary ability, and has composed many songs which have been sung with great success. For seven years he was president of the Apollo Musical Club of Chicago, and he is now an honorary member of that organization.

Obituary.

MR. HENRY M. WATSON, a past-president of the American Street Railway Association and a director of the International Railway, Buffalo, N. Y., is dead. Mr. Watson was born in Unadilla, N. Y., May 18, 1835, and in 1879 organized the Bell Telephone Company, Buffalo, N. Y., being president of the company up to the time of its absorption by the New York Telephone Company, about a year and a half ago. Mr. Watson was also a director in the New York Telephone Company.

MR. RUTHERFORD D. RUBRIGHT, auditor of the Edison Electric Illuminating Company of Brooklyn, died April 20 after a short illness. Mr. Rubright was thirty-five years old and came to the Brooklyn Edison company from the Westchester Lighting Company in November, 1909. Prior to that he had been chief clerk in the accounting department of the Consolidated Gas Company, and he was at one time clerk and accountant with the Elmira Water Works Company. He was highly regarded in Brooklyn, and the offices were closed early last Thursday as a token of respect. The interment was at Corning, N. Y., where his mother and sister still reside. Mr. Rubright was a bachelor.

MR. JOHN DENNIS KEILEY, electrical engineer of the New York Central & Hudson River Railroad, died of pneumonia at his residence, Yonkers, N. Y., April 21. Mr. Keiley was born in Brooklyn Feb. 6, 1871, and received his primary education in the Christian Brothers' School of that city. He later entered the St. Francis Xavier College, of New York City, and upon the completion of his course went to Johns Hopkins University, where he took a four years' scientific course, specializing in electrical engineering. Upon finishing this course, in 1893, he undertook some civil engineering work in South Carolina. In 1897 Mr. Keiley's services were secured by the Brooklyn Rapid Transit Company in connection with the reconstruction of the Brighton Beach Railroad, and after a few months he was made assistant engineer. His natural work, however, was in the electrical field, and his opportunity came when train movement tests were inaugurated by the Brooklyn Heights Railroad Company. While engaged in this work he invented an instrument to record automatically the movement of the trains and simultaneously the readings of electrical instruments. This device was called by his associates the "Keileyograph," a name which it still bears. Mr. Keiley's excellent record led to his appointment as assistant master mechanic, in which capacity he acted as technical adviser to the vice president of the Brooklyn Rapid Transit Company, a position which he retained until 1903. When the Electric Traction Commission of the New York Central Railroad was organized Mr. Keiley was asked to become assistant electrical engineer. He entered upon this work Feb. 1, 1903, and immediately began to solve the problems which attended the first great trunk-line electrification. His unbounded enthusiasm, broad experience and clear, logical mind were the inspiration of all with whom he was associated. His familiarity with civil, mechanical and electrical engineering, in addition to his high mathematical talent, was of the greatest assistance to the commission, and in recognition of his valuable services he was appointed electrical engineer in 1906. Among Mr. Keiley's inventions are a self-ventilated armature, the Keileyograph and a hand-brake system for street cars. He also developed many of the practical details of the New York Central type of under-contact third rail. His most valuable contribution to the art of electric railroading was the circuit-breaker house system of third-rail connection, which has been the means of saving vast sums of money in copper cables and of increasing the safety of electrically operated railways. In 1907 Mr. Keiley, collaborating with Prof. S. W. Ashe, brought out a book entitled "Electric Railways." Mr. Keiley was a member of the Engineers', Transportation, and New York Railroad clubs.

Trade Publications.

METALLIC FILAMENT LAMPS.—The General Incandescent Lamp Company, Electric Building, Cleveland, Ohio, is issuing revised price lists on its "Mazda" and tantalum lamps. The price lists are rather unusual in form, the cover being a greatly enlarged reproduction of the G. I. label.

DIRECT-CURRENT GENERATORS.—The Triumph Electric Company, Cincinnati, Ohio, has issued Bulletin No. 421, giving a complete description of its belted generators of the steel-frame type, rated at from 0.5 kw to 100 kw in bracket form, and from 100 kw to 500 kw in pedestal form.

GLASS FITTINGS FOR ELECTRIC LAMPS.—In publication No. 616 of Veritys, Ltd., Aston, Birmingham, England, are shown numerous illustrations of crystal glass fittings for use with electric lamps. The fittings are shown with pendent, ceiling and bracket fixtures and with portable lamps.

GENERATING SETS.—The Gregory Electric Company, Chicago, Ill., has issued an interesting circular in which attention is called to the generating equipment of the Boley (Okla.) Light & Power Company, which has been installed and is owned and operated by colored men in a negro town, the first of its kind in America.

BUSINESS NOTES.

THE DOMESTIC EQUIPMENT COMPANY, formerly of 1304 Masonic Temple, has moved to 28 West Lake Street, Chicago.

JENKINS BROTHERS, valve manufacturers, have moved their New York headquarters from 71 John Street to 80 White Street.

THE WALL-WIN COMPANY, 27 William Street, New York, has taken over the business of the Electric Motor & Equipment Company, Newark, N. J.

THE MASSACHUSETTS CHEMICAL COMPANY and the WALPOLE RUBBER COMPANY will move their New York offices to 80 Reade Street on May 1.

THE A. O. SCHOONMAKER COMPANY has moved from 221 Fulton Street to 66 Park Place, New York, where it will have on hand a complete line of mica for insulating purposes.

WALPOLE RUBBER COMPANY.—Mr. E. C. Green has again become associated with the Walpole Rubber Company, as general purchasing agent, with headquarters at the factory office in Walpole, Mass.

MR. WILLIAM S. TURNER, formerly manager of W. S. Barstow & Company, has opened an office in the Spaulding Building, Portland, Ore., where he will conduct the business of consulting electrical engineering.

THE COLUMBIA INCANDESCENT LAMP COMPANY has moved its Philadelphia office from the Real Estate Trust Building to the Philadelphia Bourse Building, where the offices and warerooms will both be located.

THE CUTLER-HAMMER MANUFACTURING COMPANY announces the removal of its Chicago office from the Monadnock Building to 122 South Michigan Avenue (1339 People's Gas Building), where it will have more spacious quarters.

THE TRIUMPH ELECTRIC COMPANY has moved its Boston office from 101 High Street to 92 Pearl Street. Mr. C. A. Cotton is district office manager. This change of location was made for the purpose of obtaining more commodious quarters.

KALENBORN & PAHL.—Messrs. A. S. Kalenborn and A. J. Pahl have opened an electrical repairing establishment at 37 Stevenson Street, San Francisco, Cal. The firm will also undertake tests on hydroelectric plants and on motor-driven installations.

MR. CHARLES T. PHILLIPS, consulting electrical engineer, has moved his office from the Crocker Building to the Pacific Building in San Francisco, where he will be associated with Mr. W. F. Lamme, formerly consulting engineer of the Westinghouse company.

THE NEW DEPARTURE MANUFACTURING COMPANY, of Bristol, Conn., manufacturer of ball bearings, is enlarging its already extensive corps of engineers. Mr. Victor E. Page, of Pawtucket, R. I., for some years past managing editor of the *Automobile Journal*, is the latest recruit of the forces.

JAS. A. GREEN & COMPANY, Inc., with offices at 226 South La Salle Street, Chicago, and 509 Overland Building, Boise, Idaho, have taken over the engineering and construction business formerly conducted by James A. Green. The company will continue to pay particular attention to irrigating, hydraulic and hydroelectric work.

IRWIN ELECTRIC COMPANY.—As a result of the purchase by Mr. W. H. Irwin of the interests owned by Mr. J. H. Shores in the Joimer-Shores-Irwin Electric Company, the firm name will be changed to the Irwin Electric Company. This firm of engineers, contractors and supply dealers has its headquarters at Spartanburg, S. C.

ADAMS-BAGNALL ELECTRIC COMPANY.—Owing to a typographical error the new address of the Chicago office of the Adams-Bagnall Electric Company was given in our issue of April 20 as 217 instead of 417 South Dearborn Street, which latter address is the correct one according to the new system of street names and numbers used in Chicago.

THE HOLOPHANE COMPANY.—Mr. C. A. Howe, manager of the Chicago office of the Holophane Company, is about to leave Chicago to become treasurer and general manager of the new Holophane Company, Ltd., of Toronto, Ont., which will manufacture and sell Holophane products in Canada. Mr. Howe has been manager of the Chicago office of the Holophane Company for four years and has been nine years with the company. Mr. H. D. Howe, general purchasing agent of the Holophane Company, Newark, Ohio, will remove to Toronto to become secretary of the newly organized company.

FEDERAL MINIATURE LAMP COMPANY.—The Federal Miniature Lamp Company has recently selected for its president and general manager Mr. W. R. Armstrong, who has made a special study of miniature and novel types of lamps for the past twenty years. Mr. Armstrong's chief assistants in the operation of the company are Mr. O. V. Maurer, formerly factory expert of the Fostoria Incandescent Lamp Company and now on a tour of investigation in Europe: Mr. R. O. Poag, formerly of the engineering department of the National Electric Lamp Association, and Mr. B. F. Whelan, formerly of the Buckeye Electric Company.

THE ALPHA ELECTRICAL SUPPLY COMPANY has been formed with the following officers: Mr. John F. Walsh, president and treasurer; Mr. Albert F. Thatcher, vice-president; Mr. George J. Osburg, secretary. Mr. Walsh has been connected with the Royal Eastern Electrical Supply Company for the past six years. Formerly he was connected with the Manhattan Electrical Supply Company and the Stanley-Patterson Company. Mr. Thatcher is at present New York sales agent for the Lynn Incandescent Lamp Company, Lynn, Mass., and the Helios Manufacturing Company, of Philadelphia. Mr. Osburg has been connected with the Fullerton Electric Company for the past two years. The new company will occupy offices at 130 West Thirty-second Street, New York, where a complete line of electrical supplies will be carried and a general jobbing business will be conducted.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 18, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

989,568. ELECTRIC FURNACE; M. R. Conley, New York, N. Y. App. filed June 14, 1910. Resistance furnace in one piece, having a melting chamber with a closed bottom, an integral body of less width than the melting chamber and connecting with the walls of the melting chamber near the bottom, the body being of better conductivity than the walls of the melting chamber.

989,576. TELEGRAPHY; P. B. Delany, South Orange, N. J. App. filed May 1, 1907. Auto-dot transmitter, one movement of the key giving a plurality of dots. Comprises a weighted springy vibrator, normally attracted by an electro-magnet, so as to keep it under tension, the circuit being released at will to permit it to vibrate at its normal rate, and a transmitting contact with which the vibrator successively makes contact as it vibrates.

989,577. TELEGRAPHY; P. B. Delany, South Orange, N. J. App. filed Aug. 24, 1910. Automatic telegraph for way circuits, having a transmitter, an electro-magnetic receiver, a resistance shunting the latter, and a chemical recorder shunting the electro-magnetic receiver and the resistance, whereby the circuit is maintained stable regardless of the number of stations, and whereby a chain from one system to the other does not disturb materially the working condition of the circuit.

989,584. ELECTRIC CONTROL FOR ELEVATORS; E. L. Dunn, Worcester, Mass. App. filed June 5, 1908. For passenger elevators which may be used for freight; includes an operating box, an indicator, limit circuits closed by the main switch, a stop solenoid switch, test switch, slow-speed connections, the box being inoperative at all proper times and foolproof. Two clutches operate the direction switches and magnetically release an operating box hand wheel. The signal lamp acts as a protective resistance to keep the solenoid from heating.

989,588. COOLING DEVICE FOR TELEPHONE-TRANSMITTERS; C. E. Egnee, Stockholm, and J. G. Holmstrom, Saltsjo-Storängen, Sweden. App. filed Aug. 18, 1909. A strained diaphragm which is prevented from losing its tension by heat where it supports the electrode, by means of a spirit containing cooling liquid.

989,596. METHOD OF PROTECTING ARTICLES FROM EARTH CURRENTS; H. Geppert, Karlsruhe, Germany. App. filed Feb. 24, 1909. The article to be protected is connected with a negative pole of a circuit and anodes sunk into the earth are connected to the positive pole.

989,609. REGULATING MEANS FOR ELECTRIC MOTORS; C. De Kando, Budapest, Austria-Hungary. App. filed Sept. 26, 1907. For polyphase induction motors for railways. Regulates by means of electro-magnetically controlled devices which respond to variations in the amount of current supplied to one motor for governing the amount of current supplied to the remaining motors.

989,618. PENDENT SNAP SWITCH; R. E. Leve, New York, N. Y. App. filed April 6, 1910. Locks the switch in either position and strikes it a hammer blow by means of a toggle with a hammer at the knuckle, which strikes the switch blade.

989,623. LAMP SOCKET; N. Marshall, Newton, Mass. App. filed Oct. 19, 1908. The contacts are mounted upon a porcelain base inclosed within a metallic shell and cap, with a cord aperture in the top, insulating bushing projecting through the aperture, the shell and cap having latching devices arranged about the axis with a locking shoulder engaged by axial movement between the cap and shell.

989,671. ELECTRIC FURNACE; A. Voelker, Beuel, near Bonn, Germany. App. filed Aug. 13, 1909. Electric furnace for turning raw quartz into a semi-liquid hot state and to form bodies from the quartz during its discharge, the furnace having a covered part with central bottom opening and two prisms of carbon forming the poles, the upper pole in the cover of the hearth being fixed and the lower pole closing the bottom opening and moving downward while supporting the body being formed.

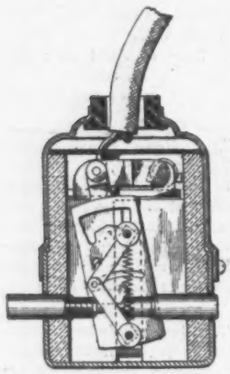
989,687. SELF-STARTER; T. E. Barnum, Milwaukee, Wis. App. filed March 14, 1907. Controller for electric motors having the main switch, a resistance-controlling switch, a single electro-magnet for operating them, the winding having two movable cores, each connected to one of the switches.

989,698. ARC LAMP; W. F. Davis, Grand Rapids, Mich. App. filed April 20, 1909. For locomotive headlights, etc., with automatic means for adjusting the carbons, including a drum turned by a spring to move the carbon holders toward each other, a lever, a clutch on the lever to hold the drum, a solenoid to move the lever in one direction, a stop to release the clutch and a spring to move the lever in the opposite direction and separate the carbon holders.

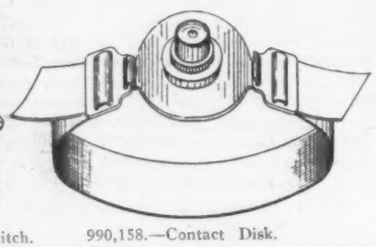
989,711. ELECTRIC MEASURING INSTALLATION; B. G. Jamieson, Chicago, Ill. App. filed Feb. 14, 1908. For testing measuring instru-

ments while on the switchboard. Associates a switch mounted upon or near the instrument so as to connect it with the service circuit or with the testing circuit, and when an ammeter is being tested short-circuits the service conductors which lead to and from the ammeter before the meter is connected to the testing circuit.

989,730. ELECTRIC TRACK SWITCH; J. P. Tierney, Booterstown, and J. Malone, Phibsboro, Ireland. App. filed Jan. 31, 1910. For tramways. The switch tongue is moved in either direction by an electro-magnet whose winding is connected to one end of the current-carrying conductor and at the other end to a contact in advance of the junction. The magnet is pivotally mounted to move in a horizontal plane, so as to return the switch tongue when the magnet is again energized.



989,618.—Pendent Snap Switch.



990,158.—Contact Disk.

989,738. BATTERY HOLDER; G. N. Waterbury, Jr., Washington, D. C. App. filed Jan. 14, 1910. A cell holder or cage for dry cells, with an electrical spring contact for effecting an electrical contact with the positive terminal of a dry cell and for engaging either a vertical positive terminal or a horizontal positive terminal.

989,761. TELEPHONE LOCK AND CALL-REGISTER; E. L. Buxbaum, Chicago, Ill. App. filed May 17, 1909. To be attached to an ordinary telephone for locking it normally and registering the calls. The locking bar for the hook is contained within a casing secured to the stem of the 'phone, the casing containing a register and a device controlling locking bar, which device actuates the register.

989,762. SYSTEM FOR REGISTERING CALLS AND LOCKING TELEPHONES; E. L. Buxbaum, Chicago, Ill. App. filed Dec. 2, 1909. Particularly for private exchanges, including a combined register, a signal and locking device, the signal notifying the persons near the telephone whether or not the user registered when making the call. Means at central actuate the subscriber's register and signal to indicate the length of the conversation.

989,763. SYSTEM FOR REGISTERING TELEPHONE CALLS; E. L. Buxbaum, Chicago, Ill. App. filed Aug. 5, 1910. For registering outgoing calls simultaneously at subscriber's station and central by means of an actuating magnet for the register controlled by wires extending to the central station, where a controller is located, together with a signal controlled by the register.

989,768. TELEPHONE SYSTEM; A. H. Dyson, Chicago, Ill. App. filed Feb. 21, 1902. Complete metallic and central energy system with subscriber's line relay, line signal lamp, local resistance closed by the relay, supervisory lamp, operater's connecting apparatus to bring the same into shunt with the line lamp to extinguish the latter, the supervisory lamp being adapted to remain unlighted because of the resistance. A second resistance in parallel with the first, when the line relay armature is retracted, causes the supervisory lamp to be illuminated by the increased current through the parallel resistances.

989,791. APPARATUS FOR INSULATING; M. Meirowsky, Cologne-Ehrenfeld, Germany. App. filed Oct. 19, 1910. For insulating form wound armature coils by winding thereon insulating material, preferably mica which is heated by hot rolls while being wound upon the form.

989,792. TELEGRAPH RELAY; Z. McD. Miller, Pittsburgh, Pa. App. filed Sept. 8, 1904. A pair of oppositely wound electro-magnets with tubular cores in axial alignment and an armature near the poles pivoted upon an axis parallel to the cores. The magnet has an open magnetic circuit to avoid residual magnetism.

989,795. SANITARY TELEPHONE MOUTHPIECE; J. B. O'Hara, Philadelphia, Pa. App. filed April 2, 1910. Mouthpiece with a cap in which is a cup which contains a disinfectant and a gasket between the cup and the inside of the cap, one edge of the gasket engaging the mouthpiece when the cap is applied.

989,798. ELECTRIC MOTOR; G. H. Pfeil, Swissvale, Pa. App. filed Feb. 4, 1910. Bushing for insulating the commutator from the armature shaft of the motor with high resistance consisting of two sections overlapped at their meeting edges, each section having a sleeve portion and an inwardly inclined end flange to retain the segments.

989,799. ELECTRIC SIGNALING APPARATUS; E. Pope, Quebec, Canada. App. filed Feb. 26, 1909. Selective signal for circuits having a multiplicity of stations, each station having a station contact selector, a ground contact selector, the selectors being moved synchronously by a clock train and means for arbitrarily making or breaking connection between the gear and the clock train by vibrating the contact carrying bearings on a pivoted frame.

989,802. ART OF EXTRACTING METALS, SUCH AS GOLD, SILVER, COPPER OR NICKEL FROM THEIR NATIVE ORES; W. D. Rennie, Hackensack, N. J. App. filed April 19, 1910. Electrolytic process by subjecting a mixture of water, powdered ore and fluorspar to electrolytic action until all the metal is deposited on the cathode of the cell.

989,803. MIXTURE OF COMPOSITION FOR USE IN THE ART OF EXTRACTING THE PRECIOUS METALS, GOLD AND SILVER, FROM THEIR NATIVE ORES; W. D. Rennie, Hackensack, N. J. App. filed April 19, 1910. A mixture used in the process of patent 989,802, consisting of water, powdered ore, fluorspar and bromin salt in certain proportions.

989,804. MIXTURE OF COMPOSITION FOR USE IN THE ART OF EXTRACTING THE PRECIOUS METALS, GOLD AND SILVER FROM THEIR NATIVE ORES; W. D. Rennie, Hackensack, N. J. App. filed April 19, 1910. A mixture for use in the process of patent 989,802, which adds cyanide of potassium to the mixture of patent 989,803.

989,814. AUXILIARY TELEPHONE-RECEIVER; W. Schwarzhaupt, Cologne, Germany. App. filed June 15, 1910. Auxiliary receiver for telephones enabling the use of both ears; the auxiliary receiver is connected by a tube to the main receiver and has its end beveled in parallel with the diaphragm.

989,847. AUTOMATIC REVERSING STARTER; J. Hofle, Budapest, Austria-Hungary. App. filed Oct. 24, 1910. Includes a change over switch for determining the direction of rotation of the motor, a resistance switch for interposing and cutting out resistance, a series circuit-breaker and dash pot for the switch lever of the resistance switch. The parts are mechanically connected, so as to insure starting with all resistances in and insure breaking the circuit only at the series circuit-breaker.

989,853. ADJUSTABLE HOLDER FOR INSULATING LOOMS; E. H. Kruse, Fort Wayne, Ind. App. filed Oct. 8, 1909. The insulating sleeve or loom which surrounds the rubber-covered wire protects it when passing through lath and plastering. The holder includes an adjusting screw and conical member for passing between the loom-covered wires to grip them and hold them in position.

989,854. ADJUSTABLE SWITCH BOX; E. H. Kruse, Fort Wayne, Ind. App. filed Oct. 14, 1909. Switch box to be used where plastering is done and to avoid the use of washers to even the plastering with the edge of the box. Provides brackets on which the box is adjustably mounted, with adjusting screws.

989,856. TELEPHONE; W. C. Lockwood, San Juan, Porto Rico. App. filed Jan. 29, 1909. Sends magnetic-induced currents and electrically induced currents over the line by vibrations of the transmitter diaphragm by providing a coil with a double primary winding and maintaining a closed circuit through one of the windings and a variable circuit through the other, the line being connected to the secondary winding.

989,892. APPARATUS FOR GENERATING ELECTRICITY; E. C. Brice and R. N. Hudson, Lexington, Ky. App. filed March 29, 1910. A battery with jar, an apertured support on the bottom, the porous cup in the top of the support, a carbon conductor receptacle within the cup, a thin porous cup within the receptacle, a vertical metal conductor on the bottom of the thin cup, having a projection to which leading wires are attached.

989,900. ELECTRICAL HEATER; J. B. Fey, Columbus, O. App. filed Feb. 11, 1910. For heating air which passes through the heater by means of a casing consisting of disks connected by an annular series of rods, around which resistance wire is wound with a deflector to cause the air to circulate.

989,960. ELECTRICAL CREMATORY; L. H. Giddings, Pasadena, Cal. App. filed Feb. 3, 1910. A retort with a slotted floor heated by electrical resistance, the slots enabling the production of a draft.

989,970. ANNUNCIATOR; C. J. Henschel, New York, N. Y. App. filed Aug. 7, 1908. An arrangement of magnet, armature and drop. Details.

990,032. ELECTRICAL RELAY; E. E. Clement, Washington, D. C. App. filed Dec. 23, 1905. A relay for breaking more than two pairs of contacts. The electro-magnet has contact springs operated by an armature over which an inclosing shell is arranged, the armature being a bell crank and operating a plurality of studs for the contacts.

990,069. SEPARATOR FOR STORAGE BATTERY PLATES; F. L. Sessions, Columbus, O. App. filed Oct. 8, 1909. Passageways extend through the plates, all parts of the ends of the passageways being offset relatively to each other in a direction parallel to the main frame of the separator.

990,103. MAGAZINE ELECTRIC ARC LAMP; J. Brockie, Forest Hill, England. App. filed July 22, 1910. A magazine contains a plurality of carbons, which are fed, one at a time, to the carbon holder. Instead of the magazine being directly linked to the regulating lever increasing the work upon the regulating armature, the regulating lever in the present instance is connected to the magazine in such a manner that an appreciative relative movement is given to the carbon holders in part of its stroke only, and further movement starts and stops the motor mechanism which feeds the carbons out of the magazine nozzles.

990,120. ELECTRIC SWITCH BOX; M. M. Disler, Canton, O. App. filed May 25, 1910. A switch having a casing which is divided into compartments with a rock shaft extending across the compartments and carrying contacts and operated by a push handle.

990,124. ELECTRIC HEATER; H. B. Gale, Natick, Mass. App. filed Dec. 29, 1910. A resistance consisting of conductive sections with radiating arms separated by insulation and a casing conforming in interior shape to the external form of the sections.

990,158. CONTACT-DISK; E. L. Moses, Buffalo, N. Y. App. filed Dec. 23, 1909. For therapeutics. A disk is made of stamped metal having the pocket carrying the felt pad. This forms the electrode.

990,161. CLOSURE FOR OPENINGS OF OUTLET BOXES; H. T. Paiste, Philadelphia, Pa. App. filed Oct. 24, 1908. A box has an opening with two plates, a screw to hold the plates so as to partially or completely close the opening, this forming a sectional wall cabinet, the outlet openings when not in use being held tightly closed.

990,180. BRIDGING BLOCK FOR DYNAMO-ELECTRIC MACHINES; F. W. Young, East Orange, N. J. App. filed Aug. 19, 1908. For holding windings in slots. The blocks act as wedges and consist of a core with a folded sheet iron envelope extending across one side of the core and folded over the opposite edges, which prevents eddy currents and magnetic leakage.

990,183. RELAY; C. G. Ashley, Chicago, Ill. App. filed Nov. 19, 1908. For propagating electrical waves, particularly as a relay in a long-distance telephone line, i. e., as a repeater to amplify the current. Two windings are out of inductive relation for connection in different circuits and a rotating inductor movable with respect to the windings is provided, one winding effecting eddy currents in the conductors, which are caused to be in primary inductive relation with the other windings.

990,200. RACK FOR ELECTROPLATING DEVICES; W. H. Rogers, Muncie, Ind. App. filed July 29, 1910. A rack for holding the articles in a bath consisting of horizontal shells with notches to receive the articles.

990,206. FOOT-WARMING ATTACHMENT FOR ELECTROTHERMAL GARMENTS; P. E. Charles, Portland, Ore. App. filed Oct. 12, 1910. Separable boots or slippers, in the lining of which resistance wire is wound with terminals that run to the supply wires of the heating circuit.